APPENDIX G

Methodology for Urban and Agricultural Demand Projections

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URBAN DEMAND

Public Water Supply and Residential Self Supplied

Public water supply (PWS) and residential self-supplied demand estimates and projections were developed for the Upper East Coast Planning Area for the years 1990 and 2010. Water supply demands were calculated by multiplying population data by per capita water use rates. Per capita water use rates were determined using the 1990 water withdrawals for each utility reported by the U.S. Geological Survey (USGS) and dividing that number by the 1990 population determined to be in the area by the U.S. Bureau of the Census. The resulting 1990 per capita water use rates were held constant to project 2010 water demand.

PWS and residential self-supplied water demands are broken down by utility service areas and planning areas (Figure G-1). Utility service area boundaries were obtained from the regional water supply utilities and incorporate areas currently serviced.

Areas outside of regional water utility service areas are referred to as planning areas. A Geographic Information Systems (GIS) coverage showing these planning areas was developed generally using the Traffic Analysis Zones (TAZs) obtained from the Metropolitan Planning Organization. By dividing each county into utility service areas and planning areas, more detailed area-specific estimates of water demand could be obtained.

Population

1990 Estimates. U.S. Census data for 1990 was used as the basis for the 1990 population, which was 252,086 (Table G-1). Block group level information was used as the basic unit of analysis. Total population, total housing units, occupied housing units, and persons per occupied housing unit were taken from Census Data. The total units connected to a public water system and total units self supplied were obtained from the Summary Tape File 3A Sample Census Data (U.S. Bureau of the Census, 1992).

The population served by PWS and the self-supplied population were calculated by multiplying the number of occupied dwelling units by the average persons per occupied unit for each respective block group. The result of this calculation was subsequently assigned to specific census block groups, assuming a uniform population distribution. These population data were input as polygon coverages into the SFWMD GIS. Utility service areas and planning areas were also entered into the GIS as polygon coverages and superimposed on the census block data in order to assign population to specific utilities.

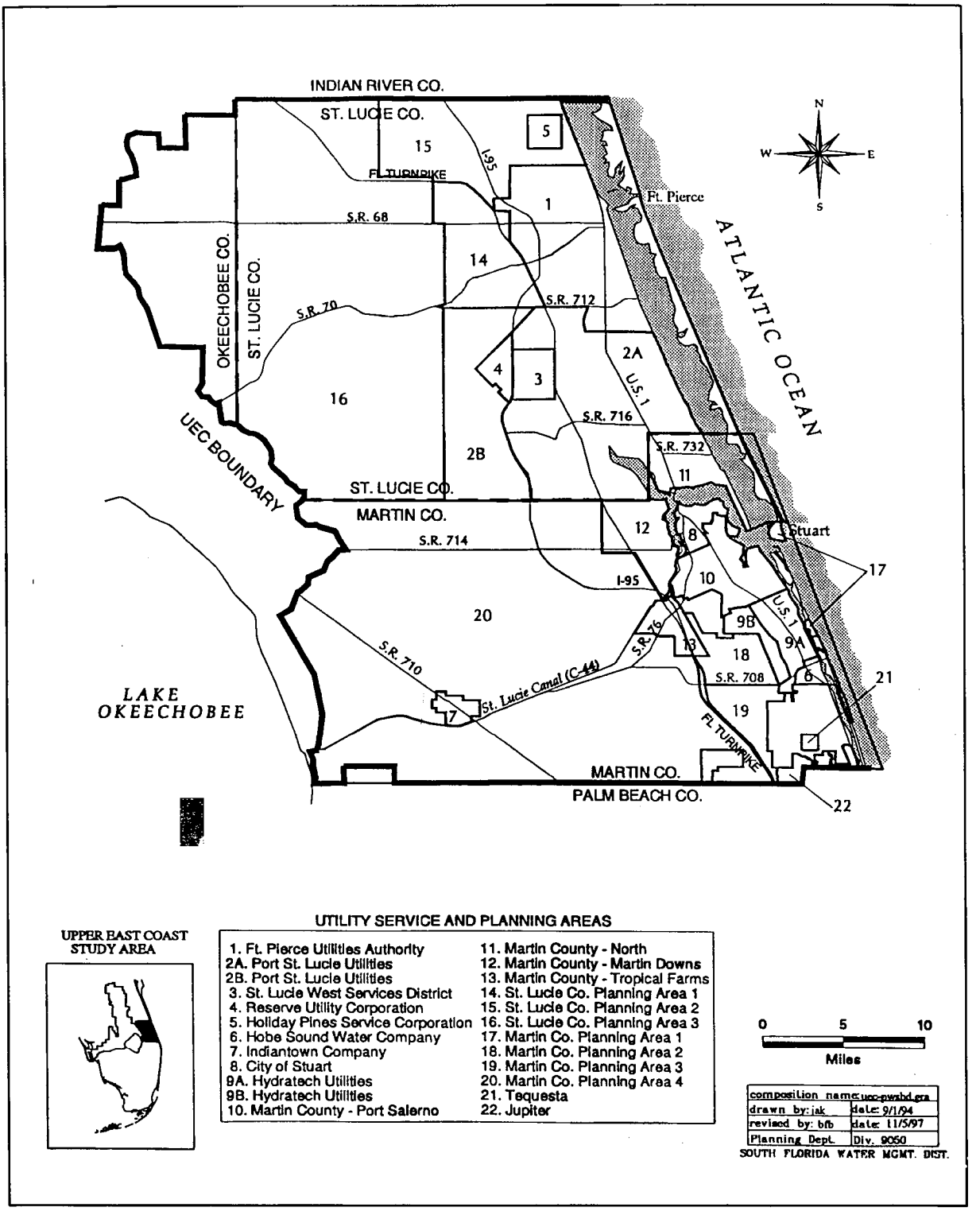

FIGURE G-1. Utility Service Areas and Planning Areas.

Assuming a uniform distribution can underestimate the population in developed areas and overestimate the population in the less developed areas. This problem is especially evident in areas where urban densities are adjacent to very low intensity development or undeveloped areas and where the census block group is split by a service area boundary.

TABLE G-l. Population Estimates and Projections in the UEC Planning Area.

Jurisdiction	1990 Census Data Estimate	2010 Comp. Plan Projection
Martin County		
Jupiter Island	549	684
Ocean Breeze Park	519	630
Sewalls Point	1,588	3,200
Stuart	11,936	15,094
Unincorp. Martin County	86,308	134,592
Martin County Total	100,900	154,200
Okeechobee County		
Unincorp. Okeechobee	1,015	1,625
Okeechobee Area Total	1,015	1,625
St. Lucie County		
Fort Pierce	36,830	55,500
Port St. Lucie	55,866	140,700
St. Lucie Village	584	833
Unincorp. St. Lucie County	56,891	93,067
St. Lucie County Total	150,171	290,100
Planning Area Total	**252,086**	**445,925**

Source: U.S. Bureau of the Census, Local Government Comprehensive Plans.

To account for this distribution problem, adjustments were made in the population estimates for the following areas:

Martin County
- Planning Areas 2 and 4
- Martin County Utilities (Port Salerno and Tropical Farms)

St. Lucie County
- Planning Areas 4 and 5
- Holiday Pines

In addition, the assumption that self-supplied population was evenly distributed led to questionable identification of potential problem areas. For example, population and its associated demand were sometimes distributed in undeveloped wetland areas, resulting in an exceedance of the wetland protection criterion. Therefore, more refined data inputs were developed for the location of self-supplied population.

Specifically, rather than distributing residential self-supplied demand evenly over an entire planning or utility service area, more precise locations for residential self supplied and small water treatment "package plant" withdrawals were determined by looking at aerial photography and meeting with utility representatives. Subsequently, areas that were identified as having no residential self-supplied demand were entered into the GIS as polygons and "masked out."

These masked out areas included:

*Areas where development was concentrated
*Publicly owned conservation lands and transportation facilities (including airports)
*Areas identified as wetlands by the National Wetlands Inventory (Martin County only)
•Areas in agricultural production

These modifications resulted in an enhanced distribution of population which was assumed to better reflect actual 1990 conditions.

2010 Projections. The 2010 population projections were based on population data in adopted local government comprehensive plans. The region's total population, 445,925, was controlled to the total future growth in the comprehensive plans. For those jurisdictions whose comprehensive plan did not extend population projections to 2010, the population projection was extrapolated to provide a 2010 population estimate.

For Martin and St. Lucie counties, the geographic distribution of the 2010 population was determined using TAZ population data. The percentage of the total population identified for a particular TAZ in the MPO plan was used as the basis for distributing the comprehensive plan population. This assumes that the MPO plan is generally consistent with the comprehensive plan as required by Chapter 339, Florida Statutes. The geographic distribution of future population in Okeechobee County was based upon the future land use element and map in the Okeechobee County Comprehensive Plan.

Using the ratios of population growth from the MPO plan to distribute the 2010 population, population densities were calculated for each TAZ, assuming a uniform density within each zone. This assumption was modified in geographically large TAZs. Future county land use maps were examined to determine the geographic areas

within the TAZ where the comprehensive plan was directing population. The larger TAZs were divided into multiple polygons consistent with the land use maps. Future growth was concentrated in the areas identified for development in the adopted and approved comprehensive plans.

The geographic areas resulting from this analysis of the TAZs were input as polygon coverages into the GIS and superimposed on the utility polygon coverages used in the 1990 analysis. The resulting coverages were joined to create a new polygon coverage. Population estimates for the year 2010 were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density. The population of all service areas were then totaled and controlled to local comprehensive plan projection totals.

As with the 1990 population estimates, areas identified as having no residential self-supplied demand were entered into the GIS as polygons and "masked out." Within both Martin and St. Lucie counties, publicly owned conservation lands and transportation facilities were defined as separate polygons with no population assigned to them in 2010. In Martin County, areas identified as wetlands in the NWI were also defined as separate polygons with no population assigned to them unless recorded plats could be identified within the wetland areas; this modification was designed to reflect Martin County's strong wetland protection program, assuming its continuation in the future. In addition, lands designated "agriculture" on Martin County's adopted future land use map were defined as discrete polygons with no 2010 population assignment, assuming that the water demand in these areas would be addressed through projections of agricultural demand. Similar modifications affecting the distribution of population in St. Lucie County were not required based upon empirical review of the data.

Per Capita Rates

Per capita water use rates for each utility were estimated using raw water withdrawal data for 1990 obtained from the USGS. This information was divided by the calculated 1990 population of the service area to calculate per capita usage rates for 1990. Per capita rates ranged from 102 MGD (Martin County/Martin Downs) to 1,205 (Hobe Sound).

Self-supplied per capita water use rates for households within a PWS utility service area were assumed to be the same as those households on the public water supply system. Within Martin County, the per capita rates for the self-supplied planning areas were assumed to be the same as the weighted average PWS per capita rate for the three county utility service areas. Total withdrawals for all three utilities were divided by the total population served in order to arrive at this weighted average. Within St. Lucie County, the self-supplied per capita use rate of Port St. Lucie was applied in the planning areas. The per capita use rate in Okeechobee County was assumed to be similar to that of the St. Lucie County planning areas.

Irrigation demand for PWS-served households using private well water for their irrigation was not estimated.

Demand

Demand was defined as population times per capita water use rate. The estimated total water demand was 43.85 MGD in 1990. Water demand is projected to increase 87 percent from 1990 to 2010 to a total water demand of 81.88 MGD.

For each service area, a PWS demand and a residential self-supplied demand were calculated for 1990 and 2010. The 2010 projections assumed the same per capita use rates as in 1990. In addition, the self-supplied population within each PWS service area (other than the Port St. Lucie and Hydratech service areas, which expanded during the period) was held constant. It was assumed that, in all service areas other than Port St. Lucie and Hydratech, all future growth would use the utility for their water source.

Within the Port St. Lucie service area, an allowance was made for growth in the recently expanded area between 1990 and the time the service area was extended. The expanded service area was treated as a sub-unit of the Port St. Lucie service area with its distinctive growth rate calculated using the methodology described above. The growth rate of this area was assumed to be constant during the period between 1990 and 2010, with all population growth in the area prior to the extension of service assumed to use residential self-supply as its water source. All population growth after the extension of the service into this area was assumed to use the utility as its source of water. Port St. Lucie is also planning to extend public water supply throughout its service area. Based on information from the utility, half of the population using residential self-supply wells in 1990 was assumed to become connected to public water supply by 2010.

Within the Hydratech service area, a similar expansion was accounted for. Estimates of the number of households within this expanded service area were obtained from the Redi-Maps for 1995, assuming a constant vacancy rate between 1990 and 1995 and a average household size consistent with that of the block group as identified in the 1990 Census. All of the households within the expanded service area in 1995 were assumed to use individual wells as their source of water. The total number of households relying on wells was assumed to remain constant between 1995 and the end of the planning period, with all subsequent growth assumed to use the utility.

Summary

The total population estimates for the UEC Planning Area for 1990 was 252,086. The projected total population for 2010 increased to 445,925. The estimated water demand for urban users was 43.85 million gallons per day (MGD) in 1990. Water

demand is projected to increase 87 percent from 1990 to 2010 to a total water demand of 81.88 MGD.

Table G-2 shows the per capita water use rate for each service area, the population estimates, and the resulting water demand for 1990. Table G-3 shows the per capita water use rate for each service area, the population projections, and the resulting water demand for 2010.

TABLE G-2. Population and Water Demand Estimates, 1990.

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
Martin County							
Hobe Sound	2,099	2.53	1,205	498	0.60	2,597	3.13
Hydratech	8,065	1.10	136	3,269	0.45	11,334	1.55
Indiantown	3,003	0.69	230	197	0.05	3,200	0.74
Jupiter	1,478	0.36	244	267	0.07	1,745	0.43
Martin Co./Martin Downs	5,368	0.55	102	6,131	0.63	11,499	1.18
Martin Co. North	9,030	1.77	196	10,461	2.05	19,491	3.82
Martin Co./Port Salerno	10,938	2.14	196	11,561	2.26	22,499	4.40
Martin Co./ Tropical Farms	0		176	627	0.11	627	0.11
Stuart	13,237	3.22	243	757	0.18	13,994	3.40
Tequesta	1,717	0.38	221	514	0.11	2,231	0.49
Planning Areas							
Planning Area 1	0		176	702	0.12	702	0.12
Planning Area 2	0		176	2,555	0.45	2,555	0.45
Planning Area 3	0		176	585	0.10	585	0.10
Planning Area 4	0		176	7,841	1.38	7,841	1.38
Martin County Total	54,935	12.74	---	45,965	8.56	100,900	21.30
Okeechobee County							
Planning Area	0		120	1,015	0.12	1,015	0.12
Okeechobee Co. Total	0	0.00	120	1,015	0.12	1,015	0.12
St. Lucie County							
Fort Pierce	53,786	9.29	173	20,337	3.51	74,123	12.80
Holiday Pines	1,921	0.38	198	1,156	0.23	3,077	0.61
Port St. Lucie	30,515	3.67	120	30,625	3.68	61,140	7.35
Port St. Lucie A							
Port St. Lucie B	0		120	694	0.08	694	0.08
Reserve	260	0.12	462	101	0.05	361	0.17
St. Lucie West	326	0.12	368	138	0.05	464	0.17
Planning Areas							
Planning Area 3A	0		120	472	0.06	472	0.06
Planning Area 3B			120	0	0.00	0	0.00
Planning Area 4A	0		120	9,719	1.17	9,719	1.17
Planning Area 4B			120	492	0.06	492	0.06
Planning Area 5	0		120	121	0.01	121	0.01
St. Lucie County Total	86,808	13.58	---	63,364	8.85	150,171	22.43
TOTAL	141,743	26.32		110,344	17.53	252,086	43.85

*GPCD = Gallons per capita per day.

TABLE G-3. Population and Water Demand Projections, 2010.

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
Martin County							
Hobe Sound	3,475	4.19	1,205	498	0.60	3,973	4.79
Hydratech							
Hydratech A	13,434	1.83	136	2,747	0.37	16,703	2.27
Hydratech B	0	1.83	136	522	0.07	522	0.07
Indiantown	4,699	1.08	230	197	0.05	4,896	1.12
Jupiter	2,403	0.59	244	267	0.07	2,670	0.65
Martin Co./Martin Downs	11,461	1.17	102	6,131	0.63	17,592	1.80
Martin Co. North	19,360	3.79	196	10,461	2.05	29,821	5.85
Martin Co./Port Salerno	24,340	4.37	196	11,561	2.26	35,754	7.00
Martin Co./ Tropical Farms	5,153	0.91	176	640	0.11	5,793	1.02
Stuart	16,296	3.96	243	757	0.18	17,053	4.15
Tequesta	2,899	0.64	221	514	0.11	3,413	0.76
Planning Areas							
Planning Area 1	0		176	1,075	0.19	1,075	0.19
Planning Area 2	0		176	2,043	0.36	2,043	0.36
Planning Area 3	0		176	895	0.16	895	0.16
Planning Area 4	0		176	11,997	2.11	11,997	2.11
Martin County Total	101,520	24.36	---	52,680	9.32	154,200	32.30
Okeechobee County							
Planning Area	0		120	1,625	0.20	1,625	0.20
Okeechobee Co. Total	0	0.00	120	1,625	0.20	1,625	0.20
St. Lucie County							
Fort Pierce	81,105	14.03	173	16,965	2.93	98,070	16.94
Holiday Pines	7,067	1.40	198	1,156	0.23	8,223	1.63
Port St. Lucie							
Port St. Lucie A	103,378	12.40	120	16,753	2.01	120,131	14.45
Port St. Lucie B			120	13,237	1.59	13,237	1.59
Reserve	9,371	4.33	462	101	0.05	9,472	4.37

*GPCD = Gallons per capita per day.

TABLE G-3. (Continued)

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
St. Lucie West	20,399	7.51	368	138	0.05	20,537	7.56
Planning Areas							
Planning Area 3A	0		120	1,760	0.21	1,760	0.21
Planning Area 3B	0		120	879	0.11	879	0.11
Planning Area 4A	0		120	12,680	1.53	12,680	1.53
Planning Area 4B	0		120	3,460	0.42	3,460	0.42
Planning Area 5	0		120	1,651	0.20	1,651	0.20
St. Lucie County Total	221,320	40.06	---	88,780	9.32	290,100	48.99
TOTAL	322,840	64.42	---	123,085	18.84	445,925	81.49

*GPCD = Gallons per capita per day.

The employment by sector was evaluated regarding the predominant types of employment found in the county, and if these employment types could be expected to grow at the **same** rate and in the same direction as the population. In the UEC Planning Area, the majority of the employees are found in the service and retail sales sectors, indicating that water demand by these sectors will generally grow along with the population. Water used for commercial and industrial purposes supplied by utilities are included with other utility demands. Self-supplied commercial and industrial demands are shown in Table G-4. Industrial self-supplied water use was assumed to increase at the **same** rate as the county population, with 1990 used as the base year.

TABLE G-4. Commercial and Industrial Self-Supplied Demand.

County	1985*	1990	1995	2000	2005	2010
St. Lucie County Population	116,235	150,171	184,514	218,858	253,201	287,544
Demand (MGD)	0.11	0.81	1.00	1.19	1.37	1.56
Martin County Population	80,909	100,900	120,532	140,163	159,795	179,426
Demand (MGD)	1.28	1.52	1.81	2.10	2.40	2.74

* 1985 population from University of Florida, Bureau of Economic and Business Research, unpublished 1988 data.

Recreation Self Supplied

Landscape

Demand projections for this section include irrigated acreage permitted for landscaping and recreation, excluding golf courses. Landscaping water use was assumed to increase at the same rate as the county population, with 1990 used as the base year. Projections for landscaping and recreation self supplied demand are outlined in Table G-5.

TABLE G-5. Landscape Self-Supplied Demand.

County	1985*	1990	1995	2000	2005	2010
St. Lucie County						
Population	116,235	150,171	184,514	218,858	253,201	287,544
Demand (MGD)	2.76	3.98	4.89	5.80	6.71	7.62
Martin County						
Population	80,909	100,900	120,532	140,163	159,795	179,426
Demand (MGD)	0.27	1.87	2.23	2.60	2.96	3.38

*** 1985 population from University of Florida, Bureau of Economic and Business Research, unpublished 1988 data.**

Golf Course

Golf courses in the UEC Planning Area are found in St. Lucie and Martin counties. There are some water demands for irrigating golf courses in Okeechobee County, but these are outside of the planning area. Historical irrigated golf course acreage data were gathered from the *Official Florida Golf Guide* (Florida Dept. of Commerce, 1990, 1991), Golf *Guide to the South* (Florida Golfweek, 1989), *The Golf Course* (Cornish and Whitten, 1988), District water use permits, and personal communication with several of the golf courses listed.

St. Lucie County. The golf courses presently in St. Lucie County are described in Table G-6, As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

The first reported golf course opening in St. Lucie County was in 1938; however there were no additional golf courses opened prior to 1961. In order to improve the model fit, these early observations, prior to 1960 were dropped from the estimation process. Equation G-l was estimated to project irrigated golf course acreage in St. Lucie County.

TABLE G-6. Golf Courses in St. Lucie County.

Name	Year Opened	Total Acres	Irrigated Acres
Indian Hills G & CC	1938	98	98
Village Hotel of Sandpiper	1960	257	234
Spanish Lakes	1971	8	8
Indian Pines CC	1971	108	50
Golf Village CC	1980	16	5
Spanish Lakes Golf Village	1980	17	8
Spanish Lakes CC	1981	25	14
Island Dunes GC*	1983	112	50
Meadowood (Monte Carlo)*	1983	394	122
Reserve G & TC, The	1984	264	146
Harbour Ridge*	1984	200	160
Gator Trace CC	1985	100	60
Savanna Club GC	1985	59	59
St. Lucie West*	1988	100	100
Spanish Lakes Fairways*	1989	56	31
Fait-winds	1991	300	144
Wilderness GC	1992	178	47
Ballentrae G & YC*	1993	188	120
Total		2,480	1,456

*Golf courses using reclaimed water.

$$CUMACRES_t = f(time_t, pop_t, d) \quad \text{(G-1)}$$

where:

$time_t$ = *1 in 1938, increasing by 1 unit per year thereafter.*

pop_t = *estimated or forecasted St. Lucie County population (in thousands) in year t.*

d = *a dichotomous variable equal to 1 for the period 1984 and after and 0 otherwise.*

Historic population data came from the Bureau of Economic and Business Research and the U. S. Bureau if the Census; forecasted population data came from the County Comprehensive Plan. When Equation G-l was estimated using ordinary least squares, the results shown in Equation G-2 were obtained.

$$CUMACRES_t = \underset{}{1963.701} - \underset{(-4.49)}{79.42*time_t} + \underset{(6.37)}{21.06*pop_t} + \underset{(6.21)}{315.670*d} \qquad \text{(G-2)}$$

Goodness of fit statistics
$R^2 = .9780$
$F = 117.85$
$Pr\,F>0>.999$
D-W = 2.214
t-statistics in parentheses

It should be noted that the negative sign on the time variable does not mean that golf courses are decreasing over time, but rather that population and golf course acreage are both increasing over time with population increasing at a faster rate than golf course acreage.

When Equation G-2 was used to project St. Lucie County golf course acreage, the results shown in Table G-7 were obtained.

TABLE G-7. Historical and Projected Irrigated Golf Course Acreage in St. Lucie County.

Year	Historical	Primary projection	Primary -15%	Primary +15%
1960	332			
1965	332			
1970	332			
1975	390			
1980	403			
1981	417			
1982	417			
1983	589			
1984	895			
1985	1,014			
1986	1,014			
1987	1,014			
1988	1,114			
1989	1,145			
1990	1,145			
1991	1,289			
1992	1,336			
1993	1,456	1,379		
Projections				
1994		1,521	1,293	1,749
1995		1,559	1,325	1,793
1996		1,624	1,380	1,868
1997		1,689	1,436	1,942
1998		1,754	1,491	2,017
1999		1,820	1,547	2,093
2000		1,885	1,602	2,168
2001		1,950	1,658	2,243
2002		2,015	1,713	2,317
2003		2,081	1,769	2,393
2004		2,146	1,824	2,468
2005		2,211	1,879	2,543
2006		2,276	1,935	2,617
2007		2,342	1,991	2,693
2008		2,407	2,046	2,768
2009		2,472	2,101	2,843
2010		2,537	2,156	2,918

The irrigation requirements in Table G-9 were calculated by applying projected irrigated acreages to the supplemental water requirements (as calculated by the Blaney-Criddle permitting model). Input variables used were irrigated acreage of grass from Table G-7, sandy soil with 0.8 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Fort Pierce as the rainfall station (Table G-8).

TABLE G-8. Supplemental Water Requirements for Grass in St. Lucie County.

Month	Average (in.)	2-in-10 (in.)
January	0.79	1.01
February	0.96	1.20
March	2.18	2.47
April	3.33	3.67
May	4.28	4.74
June	3.88	4.58
July	4.74	5.36
August	4.37	5.01
September	2.47	3.24
October	1.54	2.21
November	1.80	2.05
December	1.20	1.40
Total	**31.54**	**36.94**

Rainfall station = Fort Pierce
Soil type = 0.8 in.

TABLE G-9. Irrigation Requirements (MG) for the Primary Irrigated Golf Course Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	29	33	45	54	63	73
February	35	40	54	66	77	88
March	80	90	123	149	175	200
April	122	138	188	227	267	306
May	157	177	242	292	343	393
June	142	161	219	265	311	356
July	174	197	268	324	397	435
August	160	181	247	298	350	401
September	91	102	139	169	190	227
October	57	64	87	105	123	141
November	66	75	102	123	144	165
December	44	50	68	82	96	110
Total	**1,158**	**1,308**	**1,780**	**2,153**	**2,525**	**2,897**
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	37	42	57	69	81	93
February	44	50	68	82	96	110
March	91	102	139	169	198	227
April	135	152	207	250	294	337
May	174	197	268	324	379	435
June	168	190	259	313	367	421
July	197	222	304	366	429	492
August	184	208	283	342	401	460
September	119	134	183	221	259	298
October	81	92	125	151	177	203
November	75	85	116	140	164	188
December	51	58	79	96	112	129
Total	**1,356**	**1,531**	**2,085**	**2,521**	**2,957**	**3,393**

Martin County. The golf courses presently in Martin County are described in Table G-10. Martin County has experienced rapid growth in irrigated golf course acreage since the early 1960s. There was an over three-fold increase in Martin County irrigated golf course acreage between 1960 and 1970. Between 1970 and 1980, Martin County golf course acreage more than doubled and again more than doubled during the 1980s. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

TABLE G-10. Golf Courses in Martin County.

Name	Year opened	Total acres	Irrigated acres
Martin County G & CC	1951	304	182
Yacht & CC of Stuart	1965	220	140
* Jupiter Hills Club	1969	366	298
Monterey Yacht & CC	1970	18	18
Pine Lakes GC (Holiday)	1971	75	50
* Crane Creek (Martin Downs CC)	1972	105	85
* River Bend GC	1974	182	68
** Jupiter Island GC (Hobe Sound Water Co.)	1974	103	103
* Turtle Creek Club	1976	158	105
Evergreen Club, The	1978	70	70
* Indian River Plantation	1978	195	70
Cypress Links	1979	250	150
* Heritage Ridge	1980	110	110
* Sailfish Point GC	1981	310	250
Mariner Sands CC	1982	568	215
* Towers (Martin Downs CC)	1982	150	101
* Piper's Landing CC	1982	467	66
Old Trail	1983	326	225
* Miles Grant CC	1983	88	8 8
* Eaglewood GC	1983	164	50
Indianwood G & CC	1984	119	86
Monarch	1986	110	110
Hobe Sound GC	1987	235	110
Cobblestone CC (Stuart West)	1988	95	95
Willoughby Golf Club	1988	154	105
* Loblolly Pines GC	1988	115	85
* Cutter Sound G & YC	1990	75	65
Golf World	1990	16	8
Summerfield GC (Palmetto Cove)	1991	553	155
* Lost Lake GC (Double Tree)	1992	110	90
Total		5,811	3,353

*Golf courses using reclaimed water.
**Golf courses using PWS potable water.

The first reported golf course opening in Martin County was in 1951. However, there were no additional golf courses opened prior to 1965. In order to improve the model fit, these early observations, prior to 1965 were dropped from the estimation process. Equation G-4 was estimated to project irrigated golf course acreage in Martin County.

$$CUMACRES_t = f(time_t, logime_t, d) \quad (G\text{-}4)$$

where:

$time_t$ = *1 in 1951 and increasing one unit per year thereafter.*

$logtime_t$ = *the natural log of time.*

d = a dichotomous variable equal to 1 in 1982 and thereafter and 0 otherwise.

Equation G-4 was estimated using ordinary least squares, and adjusted for the 1990 acreage. This resulted in Equation G-5.

$$CUMACRES_t = -4036.858 + \underset{(9.33)}{181.32*time_t} - \underset{(-4.52)}{2357.70*logime_t} + \underset{(7.50)}{521*d} \quad \textbf{(G-5)}$$

Goodness of fit statistics

$R^2 = .9894$

$F = 812.54$

$Pr\,F>0>.999$

$D\text{-}W = 1.401$

t-statistics in parentheses

Equation G-5 was used to develop the primary projection of irrigated golf course acreage in Martin County. This projection is presented in Table G-11.

TABLE G-11. Historical and Projected Irrigated Golf Course Acreage in Martin County.

Year	Historical	Primary Projection	Primary -15%	Primary + 15%
1955	182			
1960	182			
1965	322			
1970	638			
1975	944			
1980	1,449			
1981	1,699			
1982	2,306			
1983	2,444			
1984	2,530			
1985	2,530			
1986	2,640			
1987	2,750			
1988	3,035			
1989	3,035			
1990	3,108			
1991	3,263			
1992	3,353			
1993	3,353			
Projec tions				
1994		3,480	2,958	4,002
1995		3,608	3,067	4,149
1996		3,738	3,177	4,299
1997		3,869	3,289	4,449
1998		4,000	3,400	4,600
1999		4,133	3,513	4,753
2000		4,267	3,627	4,907
2001		4,401	3,741	5,061
2002		4,537	3,856	5,218
2003		4,673	3,972	5,374
2004		4,811	4,089	5,533
2005		4,949	4,207	5,691
2006		5,087	4,324	5,850
2007		5,227	4,443	6,011
2008		5,367	4,562	6,172
2009		5,508	4,682	6,334
2010		5,650	4,803	6,498

The irrigation requirements in tables G-13, G-14, and G-15 were calculated by applying projected irrigated acreages (PWS supplied, non-PWS supplied and total) to the supplemental water requirements. PWS supplied refers to potable water, and does not include reclaimed water. Input variables used were total and self supplied irrigated acreage of grass, sandy soil with 0.4 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Stuart as the rainfall station (Table G-12).

TABLE G-12. Supplemental Water Requirements (inches) for Grass in Martin County.

Month	Average	2-in-10
January	1.02	1.15
February	1.24	1.38
March	2.53	2.71
April	3.76	3.97
May	4.55	4.85
June	4.18	4.65
July	4.79	5.24
August	4.73	5.14
September	2.69	3.22
October	1.76	2.22
November	2.24	2.38
December	1.34	1.47
Total	**34.83**	**38.38**

Rainfall station = Stuart
Soil type = 0.4 in.

Jupiter Island Golf Club is the only golf course in Martin County that is irrigated with potable water from a public utility. This golf course opened in 1974 and no more golf courses supplied in this manner are anticipated through 2010. Irrigation requirements for this PWS supplied golf course are presented in Table G-13.

TABLE G-13. Irrigation Requirements (MG) for the PWS Supplied Golf Courses in Martin County.

Month	Average	2-in-10
January	4	4
February	5	5
March	9	10
April	14	15
May	17	18
June	16	17
July	18	20
August	18	19
September	10	12
October	7	8
November	8	9
December	5	5
Total	130	143

TABLE G-14. Irrigation Requirements (MG) for the Non-PWS Supplied Primary Projection for Irrigated Golf Course Acreage in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	90	111	129	154	179	205
February	109	135	157	187	218	249
March	222	275	321	381	444	508
April	330	409	477	567	660	755
May	400	495	577	686	798	914
June	367	455	530	630	733	840
July	421	521	608	722	840	962
August	416	515	600	713	830	950
September	236	293	341	406	472	540
October	155	191	223	265	309	353
November	197	244	284	338	393	450
December	118	146	170	202	235	269
Total	3,061	3,790	4,420	5,251	6,111	6,995
2-in-10	1985	1990	1995	2000	2005	2010
January	101	125	146	173	202	231
February	121	150	175	208	242	277
March	238	295	344	409	476	544
April	349	432	504	599	697	797
May	426	528	616	731	851	974
June	409	506	590	701	816	934
July	460	570	665	790	919	1,052
August	452	559	652	775	902	1,032
September	283	350	409	485	565	647
October	195	242	282	335	390	446
November	209	259	302	359	418	478
December	129	160	187	222	258	295
Total	3,373	4,176	4,871	5,787	6,734	7,708

TABLE G-15. Irrigation Requirements (MG) for the Total Irrigated Golf Course Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	93	115	133	158	183	209
February	114	140	162	192	222	254
March	232	285	331	391	453	518
April	344	423	491	581	674	769
May	417	512	594	703	815	931
June	383	470	546	646	749	855
July	439	539	626	740	858	980
August	433	532	618	731	848	968
September	246	303	351	416	482	550
October	161	198	230	272	315	360
November	205	252	293	346	401	458
December	123	151	175	207	240	274
Total	**3,191**	**3,920**	**4,550**	**5,381**	**6,241**	**7,125**
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	105	129	150	178	206	235
February	126	155	180	213	247	282
March	248	305	354	419	486	554
April	364	447	519	613	711	812
May	444	546	634	749	869	992
June	426	523	607	718	833	951
July	480	590	685	810	939	1,072
August	471	578	671	794	921	1,052
September	295	362	421	497	577	659
October	203	250	290	343	398	454
November	218	268	311	368	426	487
December	135	165	192	227	263	301
Total	**3,516**	**4,319**	**5,014**	**5,930**	**6,877**	**7,852**

AGRICULTURAL DEMAND PROJECTIONS

Acreage Projections

Agricultural water demand estimates were made by time horizon and month. The techniques chosen to project crop acreages were those judged by District staff to best reflect the specific crop scenario in the Upper East Coast (UEC) Planning Area. This led to some variation in projection techniques between crop types. While it would have been ideal if a comprehensive functional form could have been used which produced tangible projections universally, no such functional form was established.

In some cases, a single mathematical model could be chosen as it accurately explained past trends, and was judged as clearly the most valid scenario for the future. In other cases, several models accurately explained past trends, and none of these provided explicitly more likely projections than the others. In those cases, the projections of several statistically valid and empirically sound models were averaged. This approach was justified by research performed at the Bureau of Economic and Business Research at the University of Florida (Mahmoud, 1984) which showed that taking the average of a number of different projections reduces the chances of making large errors and leads to more reliable projections.

Where no statistically valid trend, nor any convincing empirical knowledge on future changes in a crop's acreage in a county could be found, the crop's acreage was projected at its most recently reported level ($\pm$ 15 percent). Usually these situations arose from relatively insignificant (in terms of quantity) water users.

Irrigation requirements were calculated for the six time horizons for the primary crop acreage projections for crops using forty acres or more of land in any of the counties in the planning area. Average and 2-in-10 irrigation requirements were calculated by month using the District's modified Blaney-Criddle permitting model. Historical weather data from the rainfall station most commonly used for permitting for each crop, in each county, were used to calculate irrigation requirements. In each case, the relevant rainfall station is identified.

Irrigation Demands

A crop's supplemental water requirement is the amount of water used for evapotranspiration minus effective rainfall, while irrigation requirement includes both the supplemental water requirement and the losses incurred in getting irrigation to the crop's root zone. This relationship is expressed in Equation G-6. Irrigation efficiency refers to the average percent of total water applied that is stored in the plant's root zone.

$$\textit{Irrigation requirement} = \frac{\textit{Supplemental water requirement}}{\textit{Irrigation efficiency}}$$

Projections of irrigation system type, and the effect of the corresponding irrigation efficiencies, were based on current ratios and trends. There are three basic types of irrigation systems currently used in crop production. These are seepage (50 percent), sprinkler (75 percent), and micro irrigation (85 percent) systems. Estimated irrigation efficiencies are shown in parentheses.

Usable soil water capacity has a direct affect on effective rainfall. For each crop, assumptions for soil type were made for present and future growth. The District classifies 5 types of soil with regard to usable soil water capacity (USWC) in inches (i.e., 0.2, 0.4, 0.8, 1.5, and 3.6). The percentage distributions of these soils are shown in Table G- 16 and their locations are as shown in Figure G-2.

TABLE G-16. Soil Types in the UEC Planning Area by Percentage Distribution.

Soil Type USWC (inches)	St. Lucie County	Martin County	Okeechobee Area
0.2	0%	0%	0%
0.4	11%	15%	0%
0.8	55%	63%	26%
1.5	31%	20%	61%
3.6	3%	2%	13%

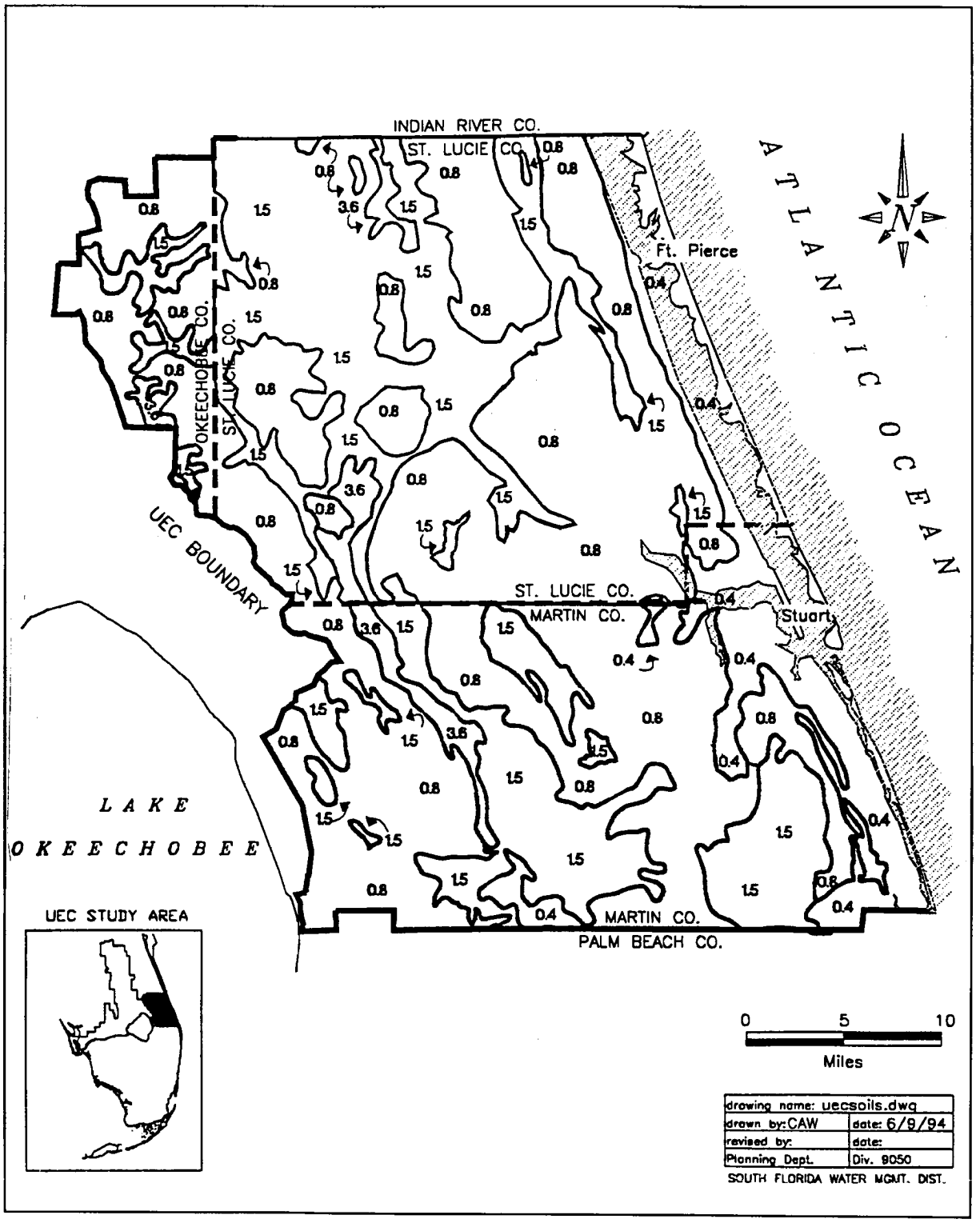

Figure G-2. Usable Soil Water Capacity in the UEC Planning Area.

Crop Types

Irrigation requirements for agriculture in the UEC Planning Area include those for citrus, sugarcane, vegetables, sod, cut flowers, ornamental nurseries and improved pasture. There are also some demands for cattle watering.

Agricultural irrigation and cattle watering demand estimates were made by crop type, time horizon and month. Historical crop acreage data were gathered from the Florida Department of Agriculture and Consumer Services' Florida Agricultural Statistics Service (FASS) and Division of Plant Industry (DPI), Institute of Food and Agricultural Sciences (IFAS), Soil Conservation Service (SCS) and District records.

Citrus

All categories of citrus (oranges, grapefruit, tangerines, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the "Commercial Citrus Inventory" which is published biennially by the Florida Agricultural Statistics Service. Citrus acreage in the UEC Planning Area was constant from 1968 through 1982. Since 1982 acreage has increased with each citrus survey concurrent with a period of post-freeze recovery and relatively high returns. A generic model of the form Equation G-7 was used to project citrus acreage.

$$XCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-7)}$$

where:

$XCIT_t$ = *County "X" citrus acreage in year t.*

time = a time-trend variable equal to 1 in 1966 and increasing one unit each year thereafter.

RP_p = *real price of pink grapefruit, in year t.*

RP_w = *real price of white grapefruit, in year t.*

RP_o = *real price of oranges, in year t.*

D = a dichotomous variable equal to 0 for the period before an observed intercept shift in the historical acreage and 1 for the period after. This is stipulated for each county if used.

For St. Lucie and Martin counties, prices are for the Indian River production district. For Okeechobee County, prices are for the Interior Region production district.

Models were run which weighted all observations equally and with the latest observation assigned the most weight. Weighted citrus acreage is denoted as WXCIT.

$$XCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-8)}$$

$$WXCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \text{(G-9)}$$

$$XCIT_t = f(time, D) \quad \text{(G-10)}$$

$$WXCIT_t = f(time, D) \quad \text{(G-11)}$$

$$XCIT_t = f(time, RP_p, RP_w, RP) \quad \text{(G-i2)}$$

$$WXCIT_t = f(time, RP_p, RP_w, RP) \quad \text{(G-13)}$$

$$XCIT_t = f(time) \quad \text{(G-14)}$$

$$WXCIT_t = f(time) \quad \text{(G-15)}$$

The three basic types of irrigation systems used in citrus production are seepage, overhead sprinkler, and micro irrigation. All three types of irrigation systems are currently used in citrus production. In recent years micro irrigation has been the system of choice on new citrus groves for a variety of reasons. These include the cost advantage that micro irrigation systems have over sprinkler systems, and the production advantage (less time to tree maturity) micro irrigation systems have over seepage systems. However, there are still substantial citrus acreages in the Planning Area which use seepage irrigation, and to a lesser extent, sprinkler irrigation.

St. Lucie County. Functional forms G-8 through G-15 were estimated using ordinary least squares regression. The results are shown in equations G-16 through G-23. Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time) the major difference in forecasts results from differences in the estimates of the coefficient on the time variable. The dichotomous variable (D) is set equal to 0 for the period 1976 and before and 1 for the period after 1976.

$$SLCIT_t = 56461.57 + 1650.707 * time - 2409.074 * RP_p + 4664.374 * RP,$$
$$(8.61) \qquad (-2.01) \qquad (4.25)$$
$$- 689.096 * RP_o - 8030,918 * D \quad \text{(G-16)}$$
$$(-0.84) \qquad (-2.16)$$

Goodness of fit statistics
$R^2 = .9647$
$F = 43.75$
$Pr F>0 >.999$
$D\text{-}W = 2.421$
t-statistics in parentheses

$$WSLCIT_t = -13054.93 + 4107{,}119 * time - 3479.403 * RP_p + 5701.989 * RP_w$$
$$(19.28) \qquad (-2.61) \qquad (4.68)$$
$$- 690.9116 * RP_o - 6908.817 * D \qquad \text{(G-17)}$$
$$(-0.76) \qquad (-1.68)$$

Goodness of fit statistics
$R^2 = .9948$
$F = 305.36$
$Pr\ F>0>.999$
D-W = 1.290
t-statistics in parentheses

$$SLCIT_t = 61797.42 + 1779.097 * time - 13063.73 * D \qquad \text{(G-18)}$$
$$(5.68) \qquad (-2.56)$$

Goodness of fit statistics
$R^2 = .8276$
$F = 26.40$
$Pr\ F>0 >.999$
D-W = .8606
t-statistics in parentheses

$$WSLCIT_t = -9103.637 + 4246.372 * time - 11609.76 * D \qquad \text{(G-19)}$$
$$(11.95) \qquad (-2.01)$$

Goodness of fit statistics
$R^2 = .9735$
$F = 202.11$
$Pr\ F>0 >.999$
D-W = .699
t-statistics in parentheses

$$SLCIT_t = 558518.45 + 1303.601 * time - 2094.726 * RP_p + 5023.689 * RP_w$$
$$(10.45) \qquad (-1.48) \qquad (3.90)$$
$$-1745.339 * RP_o \qquad \text{(G-20)}$$
$$(-2.23)$$

Goodness of fit statistics
$R^2 = .9441$
$F = 37.97$
$Pr\ F>0>.999$
D-W = 2.344
t-statistics in parentheses

$$WSLCIT_t = -11285.45 + 3808.513 * time - 3208.977 * RP_p + 6011.099 * RP_w - 1599.57 * RP_o \quad \textbf{(G-21)}$$
(29.76) (-2.21) (4.55) (-1.99)

Goodness of fit statistics
$R^2 = .9930$
$F = 317.28$
$Pr F>0 >.999$
$D\text{-}W = 1.223$
t-statistics in parentheses

$$SLCIT_t = 63979.49 + 1090.021 * time \quad (G\text{-}22)$$
(5.62)

Goodness of fit statistics
$R^2 = .7250$
$F = 31.63$
$Pr F>0 >.999$
$D\text{-}W = .600$
t-statistics in parentheses

$$WSLCIT_t = -7164.425 + 3633.989 * time \quad (G\text{-}23)$$
(17.88)

Goodness of fit statistics
$R^2 = .9638$
$F = 319.63$
$Pr F>0>.999$
$D\text{-}W = .406$
t-statistics in parentheses

Equations G-16 through G-23 were used to calculate the alternatives projections in columns G-16 and G-23 in Table G-17.

TABLE G-17. Alternative Projections for Citrus Acreage in St. Lucie County.

Year	Historical	Column (G-16)	Column (G-17)	Column (G-18)	Column (G-19)	Column (G-20)	Column (G-21)	Column (G-22)	Column (G-23)
1966	63,703								
1968	74,962								
1970	75,397								
1972	73,822								
1974	73,036								
1976	73,912								
1978	70,462								
1980	75,140								
1982	76,863								
1984	80,402								
1986	82,770								
1988	88,893								
1990	94,878								
1992	105,117								
Projections									
1993		105,472	106,329	98,548	98,185	104,721	105,683	94,500	94,587
1994		107,123	110,436	100,328	102,431	106,024	109,491	95,590	98,221
1995		108,774	114,543	102,107	106,678	107,328	113,300	96,680	101,855
1996		110,424	118,651	103,886	110,924	108,632	117,108	97,770	105,489
1997		112,075	122,758	105,665	115,171	109,935	120,917	98,860	109,123
1998		113,726	126,865	107,444	119,417	111,239	124,725	99,950	112,757
1999		115,376	130,972	109,223	123,663	112,542	128,534	101,040	116,391
2000		117,027	135,079	111,002	127,910	113,846	132,342	102,130	120,025
2001		118,678	139,186	112,781	132,156	115,150	136,151	103,220	123,659
2002		120,329	143,293	114,560	136,402	116,453	139,959	104,310	127,293
2003		121,979	147,400	116,339	140,649	117,757	143,768	105,400	130,927
2004		123,630	151,508	118,119	144,895	119,060	147,576	106,490	134,561
2005		125,281	155,615	119,898	149,142	120,364	151,385	107,580	138,195
2006		126,931	159,722	121,677	153,388	121,668	155,193	108,670	141,829
2007		128,582	163,829	123,456	157,634	122,971	159,002	109,760	145,463
2008		130,233	167,936	125,235	161,881	124,275	162,810	110,850	149,097
2009		131,884	172,043	127,014	166,127	125,578	166,619	111,940	152,731
2010		133,534	176,150	128,793	170,373	126,882	170,427	113,030	156,365

An analysis of the projections from equations G-16 through G-23 showed that equations G-17, G-19, G-21, and G-23, which used the weighted acreage as the dependent variable consistently yielded projections which were considered unreasonably high, particularly for the later years of the projection period. Consequently, to develop a primary projection for citrus acreage in St. Lucie County, projections from equations G-16, G-18, G-20, and G-22 were calculated and these results were averaged and adjusted for the 1992 observation to arrive at a primary projection. The resulting primary projection is shown in Table G-18.

TABLE G-18. Historical and Projected Citrus Acreage in St. Lucie County.

Year	Historical	Primary projection	Primary -15%	Primary+ 15%
1966	63,703			
1968	74,962			
1970	75,397			
1972	73,822			
1974	73,036			
1976	73,912			
1978	70,462			
1980	75,140			
1982	76,863			
1984	80,402			
1986	82,770			
1988	88,893			
1990	94,878			
1992	105,117	99,357		
Projections				
1993		106,571	90,585	122,556
1994		108,027	91,823	124,231
1995		109,482	93,060	125,905
1996		110,938	94,298	127,579
1997		112,394	95,535	129,253
1998		113,850	96,773	130,928
1999		115,306	98,010	132,602
2000		116,762	99,248	134,276
2001		118,218	100,485	135,950
2002		119,674	101,722	137,625
2003		121,129	102,960	139,299
2004		122,585	104,197	140,973
2005		124,041	105,435	142,647
2006		125,497	106,672	144,321
2007		126,953	107,910	145,996
2008		128,409	109,147	147,670
2009		129,864	110,385	149,344
2010		131,320	111,622	151,018

In St. Lucie County there are some older citrus groves on low lying heavy soils which are not irrigated. In 1990 these groves made up about 10 percent of the citrus acreage in the county and are subtracted in the calculation of irrigation requirements.

The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. This ratio was applied to the irrigated acreage for 1990, and the corresponding efficiencies used to calculate irrigation requirements. All citrus planted after 1985 was assumed to have some form of micro irrigation system. In October 1990 permitted citrus acreage in St. Lucie County had irrigation systems in the ratio shown in Table G-19.

TABLE G-19. Ratio of Permitted Irrigation System Type on Citrus in St. Lucie County.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	61	0.85
Sprinkler	7	0.75
Seepage	32	0.50

In 1990 about half of the citrus acreage permitted by the District in St, Lucie County was on soil with a usable soil water capacity of 0.8 inch, and half on 1.5 inch soil. Future citrus acreage is anticipated to have a similar soil type ratio. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Ft. Pierce for the two soil types, and the average of the two are shown in Table G-20.

TABLE G-20. Supplemental Water Requirements (MG) for Citrus in St. Lucie County.

Month	Avg. (0.8 in.)	2-in-10 (0.8 in.)	Avg. (1.5 in.)	2-in-10 (1.5 in.)	Overall Avg.	Avg. 2-in-10
Januarv	1.30	1.52	1.09	1.36	1.20	1.44
February	1.28	1.53	1.06	1.35	1.17	1.44
March	1.95	2.24	1.70	2.03	1.83	2.14
April	2.52	2.85	2.23	2.62	2.38	2.74
May	3.07	3.49	2.69	3.19	2.88	3.34
June	2.51	3.15	1.95	2.70	2.23	2.93
July	3.24	3.81	2.74	3.40	2.99	3.61
August	2.99	3.57	2.48	3.16	2.74	3.37
September	1.49	2.21	0.85	1.70	1.17	1.96
October	0.98	1.63	0.41	1.17	0.70	1.40
November	1.80	2.05	1.57	1.87	1.69	1.96
December	1.54	1.74	1.36	1.59	1.45	1.67
Total	24.67	29.79	20.13	26.14	22.40	27.97

Rainfall station = Ft. Pierce.

Table *G-20* shows the supplemental water requirement by month for citrus in St. Lucie County. To yield the irrigation requirement, these numbers must be divided by the irrigation efficiency.

Example: Irrigation requirement for citrus in July 1990.

Assumptions:

- Citrus acreage for St. Lucie County in 1990 = 94,878 ac.
- 90 percent of citrus in St. Lucie County is irrigated = 85,390 ac.
- Half citrus acreage on 0.8 in. soil and half on 1.5 in. soil.
- 61 percent using micro irrigation = 52,088 ac. @ 85 percent eff.
- 7 percent using sprinkler irrigation = 5,977 ac. @ 75 percent eff.
- 32 percent using seepage irrigation = 27,325 ac. @ 50 percent eff.

Calculation:

The average irrigation requirement for citrus in July of 1990 is:

*(((2.99 in./0.85) * 52,088 ac.) + ((2.99 in./0.75) * 5,977 ac.)*
*+ ((2.99 in./0.50) * 27,325 ac))/ 12 in. = 30,872 ac.ft.*
(30,872 ac.ft. x 325,872 gal/ac.ft.)/1,000,000 = 10,060 mg

The irrigation requirements for 1985 were estimated by subtracting the 1985 acreage from the 1990 total, and assuming that all citrus planted between 1985 and 1990 was put in with micro irrigation (85 percent efficient). Irrigation requirements for years future to 1990 were projected with the assumption that micro irrigation will be used on all additional acreage. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-21.

TABLE G-21. Irrigation Requirements (MG) for the Primary Citrus Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	3,513	4,021	4,578	4,856	5,134	5,412
February	3,440	3,937	4,482	4,755	5,027	5,299
March	5,365	6,140	6,992	7,416	7,841	8,265
April	6,982	7,991	9,099	9,651	10,204	10,756
May	8,467	9,690	11,034	11,704	12,373	13,043
June	6,556	7,503	8,544	9,062	9,581	10,099
July	8,790	10,060	11,455	12,151	12,846	13,541
August	8,041	9,202	10,478	11,114	11,750	12,386
September	3,440	3,937	4,482	4,755	5,027	5,299
October	2,043	2,338	2,663	2,824	2,986	3,148
November	4,954	5,669	6,456	6,847	7,239	7,631
December	4,263	4,879	5,555	5,892	6,230	6,567
Total	65,855	75,367	85,819	91,028	96,238	101,447
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	4,234	4,845	5,517	5,852	6,187	6,522
February	4,234	4,845	5,517	5,852	6,187	6,522
March	6,277	7,183	8,180	8,676	9,173	9,669
April	8,041	9,202	10,478	11,114	11,750	12,386
May	9,819	11,238	12,796	13,573	14,350	15,126
June	8,599	9,841	11,206	11,887	12,567	13,247
July	10,599	12,129	13,811	14,650	15,488	16,327
August	9,893	11,322	12,892	13,675	14,457	15,240
September	5,748	6,578	7,490	7,945	8,399	8,854
October	4,116	4,710	5,364	5,689	6,015	6,340
November	5,762	6,595	7,509	7,965	8,421	8,877
December	4,895	5,602	6,379	6,766	7,153	7,541
Total	82,216	94,091	107,139	113,643	120,147	126,650

Martin County. A generic model of the form Equation G-7 was used to project Martin County citrus acreage. The variable D was included to capture the one-time increase of almost 5,400 acres between 1988 and 1990. Models were run which weighted all observations equally and with the latest observation assigned the most weight. Weighted Martin County citrus acreage is denoted $WMCIT_t$. Between 1966 and 1968, Martin County citrus acreage almost doubled, increasing from 21,889 acres to 39,157 acres. To make the estimation period more accurately reflect conditions expected to prevail in the future, the 1966 observation was dropped for estimation purposes. This data selection process significantly reduces the variation in the data set; the small variation in the historical acreage data is one reason for the relatively weak explanatory power (as measured by R^2) of the models.

Between 1988 and 1990, Martin County citrus acreage increased by about 5,400 acres. This represents approximately a 13 percent increase in citrus acreage over a two-year period. This is higher than the recent historic rate of growth in Martin County citrus acreage, and results in the weighted acreage projection models producing much higher projections than the unweighted projections.

Functional forms G-8 through G-15 were estimated using ordinary least squares regression. The results are shown in equations G-24 through G-31. Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time). The major difference in forecasts results from differences in the estimates of the coefficient on the time variable.

D = a dichotomous variable equal to 1** for **1990 and 0** for all **other years.

$$MCIT_t = 41146.2 + 168.062 * time - 892.596 * RP_p + 1451.619 * RP_w - 885.605 * RP_o + 3440.252 * D \quad \text{(G-24)}$$
$$(3.54) \quad (-1.96) \quad (3.56) \quad (-4.00) \quad (3.30)$$

Goodness of fit statistics
$R^2 = .9225$
$F = 16.66$
$Pr F>0 = .999$
$D\text{-}W = 1.590$
t-statistics in parentheses

$$WMCIT_t = -818.303 + 1665.644 * time - 668.7405 * RP_p + 1220.464 * RP_w - 587.0667 * RP_o + 3034.273 * D \quad \text{(G-25)}$$
$$(41.64) \quad (-1.62) \quad (3.32) \quad (-2.66) \quad (2.99)$$

Goodness of fit statistics
$R^2 = .9977$
$F = 690.42$
$Pr\,F>0 > .999$
D-W = 1.066
t-statistics in parentheses

$$MCIT_t = 38940.43 + 140.946 * time + 3818.916 * D \quad \textbf{(G-26)}$$
$$(2.10) \qquad (2.02)$$

Goodness of fit statistics
$R^2 = .5799$
$F = 6.90$
$Pr\,F>0 = .987$
D-W = 1.069
t-statistics in parentheses

$$WMCIT_t = -1367.988 + 1631.783 * time + 3428.31 * D \quad (G\text{-}27)$$
$$(27.49) \qquad (2.06)$$

Goodness of fit statistics
$R^2 = .9895$
$F = 471.87$
$Pr\,F>0 > .999$
D-W= 0.854
t-statistics in parentheses

$$MCIT_t = 39226.18 + 248.317 * time - 416.600 * RP_p + 1152.325 * RP_w$$
$$(4.07) \qquad (-0.64) \qquad (1.94)$$
$$- 920.041 * RP_o \quad (G\text{-}28)$$
$$(-2.79)$$

Goodness of fit statistics
$R^2 = .8020$
$F = 8.10$
$Pr\,F>0 = .904$
D-W = 2.157
t-statistics in parentheses

$$WMCIT_t = -2319.800 + 1729.001 * time - 309.8541 * RP_p + 1014.484 * RP_w$$
$$(29.24) \qquad (-0.49) \qquad (1.76)$$
$$- 616.569 * RP_o \quad (G\text{-}29)$$
$$(-1.92)$$

Goodness of fit statistics
$R^2 = .9940$
$F = 333.14$
$Pr F>0 >.999$
$D\text{-}W = 1.892$
t-statistics in parentheses

$$MCIT_t = 3844\ 7.33 + 193.4038 * time \quad \text{(G-30)}$$
$$(2.75)$$

Goodness of fit statistics
$R^2 = .4082$
$F = 7.59$
$Pr F>0 = .991$
$D\text{-}W = 1.029$
t-statistics in parentheses

$$WMCIT_t = -1810.618 + 1678.872 * time \quad \text{(G-3 1)}$$
$$(26.95)$$

Goodness of fit statistics
$R^2 = .9851$
$F = 726.39$
$Pr F>0>.999$
$D\text{-}W = 0.842$
t-statistics in parentheses

Equations G-24 through G-31 were used to calculate the alternative projections in columns G-24 through G-31 in Table G-22.

TABLE G-22. Alternative Projections for Citrus Acreage in Martin County.

Year	Historical	Column (G-24)	Column (G-25)	Column (G-26)	Column (G-27)	Column (G-28)	Column (G-29)	Column (G-30)	Column (G-31)
1966	21,889								
1968	39,157								
1970	41,385								
1972	41,358								
1974	40,473								
1976	40,264								
1978	38,361								
1980	40,768								
1982	40,646								
1984	40,483								
1986	41,095								
1988	40,921								
1990	46,283								
1992	46,335								
Projections									
1993		45,593	46,674	42,887	44,322	46,444	47,447	43,863	45,198
1994		45,761	48,331	43,028	45,954	46,692	49,176	44,056	46,877
1995		45,929	49,987	43,169	47,586	46,940	50,905	44,249	48,556
1996		46,097	51,643	43,310	49,217	47,189	52,634	44,443	50.234
1997		46,265	53,299	43,451	50,849	47,437	54,363	44,636	51,913
1998		46,433	54,955	43,592	52,481	47,685	56,092	44,830	53,592
1999		46,601	56,611	43,733	54,113	47,934	57,821	45,023	55,271
2000		46,769	58,268	43,874	55,744	48,182	59,550	45,216	56,950
2001		46,937	59,924	44,014	57,376	48,430	61,279	45,410	58,629
2002		47,105	61,580	44,155	59,008	48,679	63,008	45,603	60,308
2003		47,273	63,236	44,296	60,640	48,927	64,737	45,797	61,987
2004		47,441	64,892	44,437	62,272	49,175	66,466	45,990	63,665
2005		47,609	66,548	44,578	63,903	49,424	68,195	46,183	65,344
2006		47,777	68,205	44,719	65,535	49,672	69.924	46,377	67,023
2007		47,945	69,861	44,860	67,167	49,920	71,653	46,570	68,702
2008		48,113	71,517	45,001	68,799	50,169	73,382	46,764	70,381
2009		48,282	73,173	45,142	70,430	50,417	75,111	46,957	72,060
2010		48,450	74,829	45,283	72,062	50,665	76,840	47,151	73,739

An analysis of the projections from equations G-24 through G-31 showed that equations G-25, G-27, G-29, and G-31, which used the weighted acreage as the dependent variable consistently yielded projections which were considered unreasonably high, particularly for the later years of the projection period.

To develop a primary projection for citrus acreage in Martin County, projections from equations G-24, and G-28 above were calculated, adjusted for the 1992 survey, and averaged to arrive at a primary projection. The primary citrus acreage projection is shown in Table G-23.

TABLE G-23. Historical and Projected Citrus Acreage in Martin County.

Year	Historical	Primary projection	Primary-15 %	Primary+15 %
1966	21,889			
1968	39,157			
1970	41,385			
1972	41,358			
1974	40,473			
1976	40,264			
1978	38,361			
1980	40,768			
1982	40,646			
1984	40,483			
1986	41,095			
1988	40,921			
1990	46,283			
1992	46,335	45,813		
Projections				
1993		46,540	39,559	53,521
1994		46,748	39,736	53,760
1995		46,956	39,913	54,000
1996		47,165	40,090	54,239
1997		47,373	40,267	54,479
1998		47,581	40,444	54,718
1999		47,789	40,621	54,958
2000		47,997	40,798	55,197
2001		48,206	40,975	55,436
2002		48,414	41,152	55,676
2003		48,622	41,329	55,915
2004		48,830	41,506	56,155
2005		49,038	41,683	56,394
2006		49,246	41,860	56,633
2007		49,455	42,036	56,873
2008		49,663	42,213	57,112
2009		49,871	42,390	57,352
2010		50,079	42,567	57,591

There are still substantial citrus acreages in Martin County which use seepage or sprinkler irrigation. The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. This ratio was applied to the primary projected acreage for 1990, and the corresponding efficiencies used to calculate irrigation requirements. All citrus planted after 1985 was assumed to have some form of micro irrigation system. In October 1990, permitted citrus acreage in Martin County had irrigation systems in the ratio shown in Table G-24.

TABLE G-24. Ratio of Permitted Irrigation System Type on Citrus in Martin County.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	39	0.85
Sprinkler	49	0.75
Seepage	12	0.50

All citrus production was assumed to take place on soil with a usable soil water capacity of 1.5 inches. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Indiantown are shown in Table G-25.

TABLE G-25. Supplemental Water Requirements for Citrus in Martin County.

Month	Average (in.)	2-in-10 (in.)
January	1.14	1.31
February	0.85	1.08
March	1.60	1.85
April	1.75	2.08
May	2.70	3.04
June	0.24	0.97
July	2.06	2.59
August	1.69	2.26
September	1.05	1.61
October	1.09	1.51
November	1.87	2.03
December	1.54	1.66
Total	17.58	21.99

Rainfall station = Indiantown.
Soil type = 1.5 inches.

Table G-25 shows the supplemental water requirement by month for citrus in Martin County. To yield the irrigation requirement these numbers must be divided by the irrigation efficiency. For the year 1990 the ratio presented in Table G-24 was used to calculate irrigation requirements.

The irrigation requirements for 1985 were estimated by subtracting the 1985 acreage from the 1990 total, and assuming that all citrus planted between 1985 and 1990 was put in with micro irrigation (85 percent efficient). Irrigation requirements for years future to 1990 were projected with the assumption that micro irrigation will be used on all additional acreage. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-26,

TABLE G-26. Irrigation Requirements (MG) for the Primary Citrus Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	1,737	1,937	1,962	2,000	2,038	2,076
February	1,295	1,445	1,463	1,491	1,519	1,548
March	2,438	2,719	2,754	2,807	2,860	2,913
April	2,667	2,974	3,012	3,070	3,128	3,186
May	4,115	4,589	4,647	4,736	4,826	4,916
June	366	408	413	421	429	437
July	3,139	3,501	3,545	3,614	3,682	3,751
August	2,575	2,872	2,908	2,965	3,021	3,077
September	1,600	1,784	1,807	1,842	1,877	1,912
October	1,661	1,852	1,876	1,912	1,948	1,985
November	2,850	3,178	3,218	3,280	3,343	3,405
December	2,347	2,617	2,650	2,702	2,753	2,804
Total	26,791	29,877	30,255	30,839	31,424	32,009
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	1,996	2,226	2,254	2,298	2,342	2,385
February	1,646	1,835	1,859	1,895	1,930	1,966
March	2,819	3,144	3,184	3,245	3,307	3,368
April	3,170	3,535	3,580	3,649	3,718	3,787
May	4,633	5,166	5,232	5,333	5,434	5,535
June	1,478	1,648	1,669	1,702	1,734	1,766
July	3,947	4,402	4,457	4,543	4,630	4,716
August	3,444	3,841	3,889	3,965	4,040	4,115
September	2,454	2,736	2,771	2,824	2,878	2,931
October	2,301	2,566	2,599	2,649	2,699	2,749
November	3,094	3,450	3,494	3,561	3,629	3,696
December	2,530	2,821	2,857	2,912	2,967	3,022
Total	33,512	37,371	37,844	38,576	39,307	40,038

Okeechobee Area. When equations G-8 through G-15 were estimated empirically using ordinary least squares regression, the results shown in equations G-32 through G-39 were obtained.

D = a dichotomous variable equal to 0 in 1980 and before and 1 after 1980.

$$OKEECIT_t = 3358.636 + 199.6891 * time - 688.626 * RP_p + 734.5867 * RP_w - 172.2878 * RP_o + 1384.892 * D \quad \text{(G-32)}$$
(7.34) (-3.03) (3.75) (-1.72) (2.74)

Goodness of fit statistics
$R^2 = .9849$
$F = 104.16$
$Pr\ F>0>.999$
D-W = 2.337
t-statistics in parentheses

$$WTOKEE_t = -845.6995 + 346.1192 * time - 889.90 * RP_p + 1157.19 * RP_w - 213.968 * RP_o + 534.185 * D \quad \text{(G-33)}$$
(11.12) (-3.53) (5.17) (-1.86) (0.92)

Goodness of fit statistics
$R^2 = .9884$
$F = 136.53$
$Pr\ F>0>.999$
D-W = 1.589
t-statistics in parentheses

$$OKEECIT_t = 2438.375 + 161.0 * time + 2278.125 * D \quad \text{(G-34)}$$
(4.36) (3.79)

Goodness of fit statistics
$R^2 = .9554$
$F = 117.90$
$Pr\ F>0>.999$
D-W = 1.283
t-statistics in parentheses

$$WTOKEE_t = -1022.991 + 276.7252 * time + 1785.117 * D \quad \text{(G-35)}$$
(4.72) (1.87)

Goodness of fit statistics
$R^2 = .9344$
$F = 78.30$
$Pr\,F>0>.999$

$D\text{-}W = 0.678$
t-statistics in parentheses

$$OKEECIT_t = 3743.498 + 260.0872 * time - 1014.64 * RP_p + 1024.287 * RP_w$$
$$(12.24) \qquad (-4.28) \qquad (4.74)$$
$$- 196.27 * RP_o \qquad (G\text{-}36)$$
$$(-1.49)$$

Goodness of fit statistics
$R^2 = .9707$
$F = 74.46$
$Pr\,F>0>.999$
$D\text{-}W = 2.384$
t-statistics in parentheses

$$WTOKEE_t = - 697.249 + 369.4161 * time - 1023.367 * RP_p + 1268.939 * RP_w$$
$$(20.41) \qquad (-4.99) \qquad (6.79)$$
$$- 223.219 * RP_o \qquad (G\text{-}37)$$
$$(-1.97)$$

Goodness of fit statistics
$R^2 = .9872$
$F = 173.26$
$Pr\,F>0>.999$
$D\text{-}W = 1.987$
t-statistics in parentheses

$$OKEECIT_t = 1732.407 + 281.1648 * time \qquad (G\text{-}38)$$
$$(10.24)$$

Goodness of fit statistics
$R^2 = .8974$
$F = 104.93$
$Pr\,F>0>.999$
$D\text{-}W = 1.133$
t-statistics in parentheses

$$WTOKEE_t = -1576.182 + 370.885 * time \quad (G\text{-}39)$$
$$(11.26)$$

Goodness of fit statistics
$R^2 = .9135$
$F = 126.75$
$Pr F>0>.999$
D-W = 0.676
t-statistics in parentheses

Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time). The major difference in forecasts results from differences in the estimates of the coefficient on the time variable. When equations G-32 through G-39 were used to project citrus acreage in Okeechobee County, the results shown in columns G-32 through G-39 in Table G-27 were obtained.

The primary projection was derived by averaging the adjusted projections generated by equations G-32 through G-39. All eight of these models accurately explained past trends, and were judged empirically to provide feasible projections. Table G-28 show the historical and projected acreage of citrus in Okeechobee County.

TABLE G-27. Alternative Projections for Citrus Acreage in Okeechobee County.

Year	Historical	Column (G-32)	Column (G-33)	Column (G-34)	Column (G-35)	Column (G-36)	Column (G-37)	Column (G-38)	Column (G-39)
1966	2,508								
1968	3,329								
1970	3,597								
1972	3,676								
1974	4,087								
1976	4,162								
1978	4,171								
1980	4,281								
1982	6,954								
1984	8,044								
1986	7,449								
1988	8,124								
1990	8,541								
1992	10,439								
Projections									
1993		10,355	10,456	9,225	8,510	10,846	10,646	9,605	8,809
1994		10,554	10,802	9,386	8,787	11,106	11,015	9,886	9,179
1995		10,754	11,149	9,547	9,064	11,366	11,385	10,167	9,550
1996		10,954	11,495	9,708	9,341	11,626	11,754	10,449	9,921
1997		11,153	11,841	9,869	9,617	11,886	12,123	10,730	10,292
1998		11,353	12,187	10,030	9,894	12,146	12,493	11,011	10,663
1999		11,553	12,533	10,191	10,171	12,406	12,862	11,292	11,034
2000		11,753	12,879	10,352	10,448	12,666	13,232	11,573	11,405
2001		11,952	13,225	10,513	10,724	12,926	13,601	11,854	11,776
2002		12,152	13,571	10,674	11,001	13,186	13,970	12,136	12,147
2003		12,352	13,918	10,835	11,278	13,447	14,340	12,417	12,517
2004		12,551	14,264	10,996	11,554	13,707	14,709	12,698	12,888
2005		12,751	14,610	11,157	11,831	13,967	15,079	12,979	13,259
2006		12,951	14,956	11,318	12,108	14,227	15,448	13,260	13,630
2007		13,150	15,302	11,479	12,385	14,487	15,818	13,541	14,001
2008		13,350	15,648	11,640	12,661	14,747	16,187	13,822	14,372
2009		13,550	15,994	11,801	12,938	15,007	16,556	14,104	14,743
2010		13,749	16,340	11,962	13,215	15,267	16,926	14,385	15,114

TABLE G-28. Historical and Projected Citrus Acreage in Okeechobee County.

Year	Historical	Primary projection	Primary -15 %	Primary+15 %
1966	2,508			
1968	3,329			
1970	3,597			
1972	3,676			
1974	4,087			
1976	4,162			
1978	4,171			
1980	4,281			
1982	6,954			
1984	8,044			
1986	7,449			
1988	8,124			
1990	8,541			
1992	10,439	9,524		
Projections				
1993		10,722	9,114	12,330
1994		11,005	9,354	12,656
1995		11,288	9,595	12,981
1996		11,571	9,836	13,307
1997		11,854	10,076	13,632
1998		12,137	10,317	13,958
1999		12,421	10,558	14,284
2000		12,704	10,798	14,609
2001		12,987	11,039	14,935
2002		13,270	11,280	15,261
2003		13,553	11,520	15,586
2004		13,836	11,761	15,912
2005		14,119	12,002	16,237
2006		14,403	12,242	16,563
2007		14,686	12,483	16,889
2008		14,969	12,723	17,214
2009		15,252	12,964	17,540
2010		15,535	13,205	17,865

Table G-28 shows the historical and projected citrus acreage in Okeechobee County as a whole. To generate estimates of citrus acreage in the Okeechobee Area, it was assumed that changes in crop acreage will be proportional to the current acreages within the two districts.

District land use maps for 1986-1988 show that approximately 90 percent of the citrus mapped in Okeechobee County was within the District, and 32 percent of this acreage in the District was within the Okeechobee Area. These ratios were used to divide acreage projections, and the estimated citrus acreages for the six time horizons are shown in Table G-29.

TABLE G-29. Historical and Projected Citrus Acreage in Okeechobee County.

	1985	1990	1995	2000	2005	2010
Okeechobee County	7,747	8,541	11,288	12,708	14,119	15,535
Okeechobee County within District	6,972	7,687	10,159	11,437	12,707	13,982
Okeechobee Area	2,231	2,460	3,251	3,660	4,066	4,474

The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. Permitted citrus acreage (as of March 1991) in the SFWMD portion of Okeechobee County has permitted irrigation systems in the ratio shown in Table G-30.

TABLE G-30. Ratio of Permitted Irrigation System Type on Citrus in the Okeechobee Area.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	89	0.85
Sprinkler	7	0.75
Seepage	4	0.50

District water use permits show that 89 percent of the citrus currently permitted in the Okeechobee Area has a micro irrigation system. All future citrus is expected to have micro irrigation systems. Therefore, the irrigation efficiency associated with micro irrigation systems (0.85) was used to calculate the irrigation requirement for all citrus.

All citrus production was assumed to take place on soil with a usable soil water capacity of 0.8 inches. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Okeechobee are shown in Table G-31.

TABLE G-31. Supplemental Water Requirements for Citrus in Okeechobee Counts.

Month	Average (in.)	2-in-10 (in.)
January	1.43	1.55
February	1.44	1.58
March	1.83	2.04
April	2.49	2.72
May	2.97	3.29
June	2.03	2.57
July	2.56	3.07
Auqust	2.69	3.16
September	1.64	2.15
October	1.85	2.19
November	2.22	2.33
December	1.67	1.77
Total	24.82	28.42

Rainfall Station = Okeechobee.
Soil Type = 0.8 inches.

Table G-31 shows the supplemental water requirement by month for citrus in Okeechobee County. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-32.

TABLE G-32. Irrigation Requirements (MG) for the Primary Citrus Acreage Projections in Okeechobee Area.

Average	1985	1990	1995	2000	2005	2010
January	102	112	149	167	186	204
February	103	113	150	168	187	206
March	130	144	190	214	238	262
April	177	196	259	291	323	356
May	212	233	308	347	386	425
June	145	160	211	237	264	290
July	182	201	266	299	333	366
August	192	211	279	315	349	385
September	117	129	170	192	213	234
October	132	145	192	216	240	264
November	158	174	231	260	288	317
December	119	131	173	195	217	239
Total	1,769	1,951	2,578	2,902	3,224	3,548
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	110	122	161	181	201	222
February	113	124	164	185	205	226
March	145	160	212	239	265	292
April	194	214	283	318	353	389
May	235	259	342	385	427	470
June	183	202	267	301	334	367
July	219	241	319	359	399	439
August	225	248	328	369	411	452
September	153	169	223	251	279	307
October	156	172	227	256	285	313
November	166	183	242	272	303	333
December	126	139	184	207	230	253
Total	2,026	2,233	2,952	3,323	3,692	4,062

Sugarcane

Sugarcane is initially propagated vegetatively by planting stalk cuttings. The first harvest takes place approximately 13 months after planting. Roots are left in the ground (ratooned) and yield additional crops of sugarcane which take about 12 months to reach maturity. Sugar production per unit of land surface declines gradually and progressively with each additional ratoon, and there comes a point where the increased yields associated with replanting outweigh the cost of replanting. In Florida, this point comes on average after four years (one planting and three ratoons).

After the final ratoon in the cycle is harvested on a parcel of land from November through March, and before replanting takes place from September through January, there is no sugarcane on that parcel. In Martin County the land is invariably fallowed during this period. This means that there is approximately 20 percent of the land associated with sugarcane production will not be reported as production by FASS. This 20 percent of land will not require irrigation and is not included in the projections presented here. In the UEC Planning Area, Martin County is the only sugarcane producer.

Historical sugarcane acreage data were gathered from annual volumes of the Field Crops Summary, which is published by FASS, and are presented in Table G-33.

TABLE G-33. Historical Sugarcane Acreage in Martin County.

Year	Sugarcane acreage
1975	3,015
1976	3,091
1977	3,158
1978	5,198
1979	5,722
1980	6,029
1981	6,664
1982	7,171
1983	6,724
1984	7,180
1985	12,479
1986	14,044
1987	14.211
1988	14,589
1989	14,415
1990	13,433
1991	13,455
1992	13.518

Sugarcane production in Martin County grew gradually from 3,015 acres in 1975 to 7,180 acres in 1984. Between 1984 and 1986, it almost doubled to 14,044 acres and has remained stable since. This growth between 1984 and 1986 was due to expansion by one large landowner, and according to the local IFAS extension office, no further growth is anticipated (phone conversation May 5, 1991 with Bob Whitty, County Extension Director, Martin County Cooperative Extension Service, IFAS, Stuart, FL.). There may be some slight fluctuation in acreage due to the planting cycle and weather limitations.

The primary projection for sugarcane production in Martin County was developed by averaging production acreage for the most recent seven years, which account for the period since the expansion was completed. The primary projection is 13,952 acres and the primary range is from 11,859 to 16,045 acres.

There are three basic soil types on which sugarcane is grown in Martin County (i.e., muck, loam, and sand). The average and 2-in-10 supplemental water requirements for sugarcane on each of these soil types at the rainfall station in Indiantown are shown in Table G-34.

TABLE G-34. Supplemental Water Requirements for Sugarcane in Martin County.

Soil Type USWC (in.)	Sand 0.8 Average (in.)	Sand 0.8 2-in-10 (in.)	Loam 1.5 Average (in.)	Loam 1.5 2-in-10 (in.)	Muck 3.6 Average (in.)	Muck 3.6 2-in-10 (in.)
January	0.47	0.61	0.30	0.46	0.08	0.27
February	0.00	0.02	0.00	0.00	0.00	0.00
March	1.19	1.39	0.93	1.17	0.61	0.90
April	1.64	1.19	1.29	1.61	0.87	1.25
May	3.00	3.28	2.64	2.97	2.20	2.60
June	1.49	2.14	0.67	1.43	0.00	0.56
July	3.16	3.62	2.58	3.12	1.85	2.50
August	3.15	3.67	2.50	3.11	1.69	2.41
September	1.83	2.32	1.22	1.79	0.47	1.14
October	2.57	2.94	2.08	2.53	1.49	2.02
November	2.26	2.40	2.09	2.25	1.87	2.06
December	1.85	1.95	1.71	1.84	1.55	1.70
Total	22.61	26.25	18.90	22.28	12.68	17.41

Rainfall station = Indiantown.

Historical acreage of sugarcane in Martin County was taken from Table G-33. The 1990 ratio of each soil type was taken from the District water use permits. Projected distribution of sugarcane acreage in Martin County is shown in Table G-35.

TABLE G-35. Projected Soil Type Distribution for Sugarcane in Martin County.

Soil Type	1985	1990	1995	2000	2005	2010
Sand	7,843	8,598	8,933	8,933	8,933	8,933
Loam	2,755	2,955	3,139	3,139	3,139	3,139
Muck	1,881	1,881	1,881	1,881	1,881	1,881
Total	12,479	13,434	13,952	13,952	13,952	13,952

The projected sugarcane acreages by soil type in Table G-35 and the supplemental water requirements in Table G-34 were used to calculate the irrigation demands for sugarcane in Martin County. These demands are shown in Table G-36.

TABLE G-36. Irrigation Requirements (MG) for the Primary Sugarcane Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	253	276	287	287	287	287
February	0	0	0	0	0	0
March	708	767	798	798	798	798
April	980	1,062	1,104	1,104	1,104	1,104
May	1,898	2,049	2,130	2,130	2,130	2,130
June	735	803	837	837	837	837
July	1,921	2,079	2,162	2,162	2,162	2,162
August	1,889	2,045	2,127	2,127	2,127	2,127
September	1,010	1,098	1,144	1,144	1,144	1,144
October	1,558	1,686	1,754	1,754	1,754	1,754
November	1,466	1,582	1,644	1,644	1,644	1,644
December	1,202	1,297	1,347	1,347	1,347	1,347
Total	13,621	14,744	15,335	15,335	15,335	15,335
2-in-10	1985	1990	1995	2000	2005	2010
January	356	386	402	402	402	402
February	9	9	10	10	10	10
March	859	929	966	966	966	966
April	1,182	1,278	1,329	1,329	1,329	1,329
May	2,107	2,274	2,363	2,363	2,363	2,363
June	1,183	1,286	1,339	1,339	1,339	1,339
July	2,264	2,447	2,543	2,543	2,543	2,543
August	2,275	2,459	2,557	2,557	2,557	2,557
September	1,373	1,487	1,547	1,547	1,547	1,547
October	1,837	1,985	2,064	2,064	2,064	2,064
November	1,569	1,692	1,758	1,758	1,758	1,758
December	1,280	1,380	1,433	1,433	1,433	1,433
Total	16,294	17,612	18,312	18,312	18,312	18,312

Vegetables

Vegetable crops were grouped together for projection purposes. This was validated by the lack of significant difference between the irrigation requirements of the different types of vegetables cultivated in the UEC Planning Area, and the production practices used on vegetable farms (different types of vegetables are sometimes grown interchangeably). Vegetables in the planning area are grown commercially in St. Lucie and Martin counties. There is some vegetable production in Okeechobee County, but not in that portion of the county within the planning area.

Vegetable fields are planted and harvested sequentially, and some portion of the total acreage used for vegetable production is commonly vacant. This temporal area of vegetable land vacancy effects total irrigation requirements, but it is difficult to quantify. Production timing may change for several reasons. For example, growers may enter into a contract to harvest vegetables in a specific time window, which would in turn determine their growing season. Also, as seepage irrigation is the predominant type of irrigation system used for vegetable production, some of these vacant fields are unavoidably irrigated, either in part or whole. With these constraints in mind, planting and harvesting schedules were developed on which to calculate irrigation requirements.

St. Lucie County. St. Lucie County vegetable production is included in the "East Central" area as defined by the FASS Vegetable Summaries, and acreage data for St. Lucie County individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension office, and only for 1990. These estimates are outlined in Table G-37.

TABLE G-37. Land Acreage Estimate Used for Vegetable Production in St. Lucie County, 1990.

Year	Potatoes	Cabbage	Zucchini	U-pick*	Green-house**	Total
1990	300	60	150	50	20	580

* mainly strawberries.
** mainly tomatoes.

Due to the lack of historical data, future vegetable acreage was projected at its 1990 level (± 15 percent). Present vegetable production is modest in St. Lucie County (approximately 580 acres), and is anticipated to remain constant by the local extension office. The primary projection for the six time horizons is therefore 580 acres, and the primary range is from 493 to 667 acres.

Vegetable crops in St. Lucie County (except those grown in greenhouses or u-pick operations) are usually cultivated once a year between August and December. The vegetable acreage in St. Lucie County was estimated to have a planting and harvesting schedule as shown in Table G-38. Table G-39 represents the supplemental water requirements and irrigation requirements for vegetable crops using the general cultivation schedule outlined in Table G-38, and the irrigation efficiency associated with seepage systems.

TABLE G-38. Generalized Cultivation Schedule for Vegetable Crops in St. Lucie County

Crop	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes (green house)	2	20	50	2	100	3	100	3	100	3	50	2
Zucchini	1	150	0	0	0	0	0	0	0	0	0	0
Strawberries (u-pick)	2	50	50	4	100	9	100	9	100	9	50	4
Potatoes	1	300	100	52	66	34	33	17	0	0	0	0
Cabbage	1	60	0	0	0	0	0	0	0	0	0	0
TOTAL		**580**		**58** ***		**46** ***		**29** ***		**12** ***		**6** ***

TABLE G-38. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes (green house)	0	0	0	0	50	2	100	3	100	3	100	3	50	2
Zucchini	0	0	0	0	50	13	100	26	100	26	100	26	50	13
Strawberries (u-pick)	0	0	0	0	50	4	100	9	100	9	100	9	50	4
Potatoes	0	0	0	0	0	0	100	52	100	52	100	52	100	52
Cabbage	0	0	0	0	50	5	100	10	100	10	100	10	50	5
TOTAL		**0**		**0** ***		**24** ***		**100** ***		**100** ***		**100** ***		**76** ***

* Percentage of land dedicated to relevant crop which is actually in the ground in that particular month.

** Land dedicated to relevant crop /vegetable production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-39. Supplemental Water Requirements and Projected Irrigation Requirements for Vegetables in St. Lucie County.

Month	Supplemental water requirements		Percent in ground	Irrigation requirements	
	Average (inch)	2-in-10 (inch)		Average (MG)	2-in-10 (MG)
January	1.38	1.62	60	26	31
February	1.26	1.51	50	20	24
March	1.83	2.12	30	17	20
April	2.28	2.60	10	7	8
May	2.71	3.12	10	7	9
June	2.14	2.76	0	0	0
July	2.83	3.39	0	0	0
August	2.60	3.17	20	16	20
September	1.22	1.93	100	38	61
October	0.86	1.49	100	27	47
November	1.73	1.99	100	54	63
December	1.59	1.79	80	40	45
Total	22.43	27.47		255	328

Rainfall station = Ft. Pierce.
Soil type = 0.4 inch.
Acreage = 580.

Martin County. Martin County vegetable production is included in the "Southeast" area as defined by the FASS Vegetable Summaries; therefore acreage data for Martin County individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension office, and only for the 1988-1989 growing season.

Vegetable acreage for the 1988-89 growing season is outlined in Table G-40, and was assembled in the following manner:

- Acreage data for snap beans, cucumbers, cabbage, peppers, and tomatoes were taken from the IFAS County annual Agricultural Commodity report (University of Florida, 1989). A default value for Chinese vegetables was estimated by the local IFAS extension office.

- These acreages were divided by two (to reflect the two growing seasons), and summed to yield the subtotal. IFAS reports acreage as acres of production row (i.e., 10 acres of row cultivated twice a year is reported as 20 acres).
- Fifteen percent of the subtotal was added to account for non-harvested acreage. An examination of historical planted vs. harvested acreage for vegetable crops within south Florida showed that an average of 15 percent of the acreage cultivated is not harvested. As IFAS reports harvested acreage, this 15 percent needed to be added to reflect the total acreage used for vegetable production.
- Vegetable acreage data reported in the FASS Vegetable Summaries and by IFAS represent the estimated area of land in the production rows or, as it is sometimes termed, "under plastic." The District's model for estimating irrigation requirements is based on total land acreage, which includes the land necessary for vegetable production, but does not include rows (i.e., spaces between rows, irrigation furrows, etc.). Land in rows represents approximately 60 percent of this total land (phone conversation 1991 with D. Pitts, Assistant Professor, IFAS, Southwest Florida Research and Education Center. Immokalee, FL.) so the row acreage column was divided by 0.6 to yield the total acreage column.

TABLE G-40. Vegetable Acreage in Martin County, 1988-1989.

Year	Snap-beans	Cucum-bers	Cabbage	Peppers	Tomatoes	Chin. veg.	Double crop/2 (row)	Total (row)	Total land
1988-89	100	100	500	600	500	100	950	1,093	1,821

Due to the lack of historical data, future vegetable acreage was projected at its 1989 level (± 15 percent). The primary projection is 1,821 acres, and the primary range from 1,548 to 2,044 acres for the six time horizons. The projection of vegetable acreage remaining relatively constant was consistent with empirical input from the local IFAS extension office. The generalized cultivation schedule shown in Table G-41 was developed with the assistance of the local IFAS extension office.

Vegetables are planted throughout the year, and crop ET values depend on planting dates. Average ET values were developed based on an average of Blaney-Criddle values with planting dates at the beginning of each month.

For the calculation of irrigation requirements, soil with a usable soil water capacity of 0.8 inch and data from the Indiantown rainfall station were used, as these are the variables used most by the District's Regulation Department for permitting vegetables in Martin County. Table G-41 shows the supplemental water requirements and the estimated percentage of vegetable land in production in any given month. The primary acreage projection of 1,821 was used to calculate the irrigation requirements.

TABLE G-41. Supplemental Water Requirements and Projected Irrigation Requirements for Vegetables in Martin County

Month	Average (inch)	2-in-10 (inch)	Approx. percent in ground	Average (MG)	2-in-10 (MG)
January	1.42	1.56	100	140	155
February	1.08	1.28	100	107	126
March	1.75	1.96	100	173	194
April	1.87	2.14	100	185	212
May	2.71	2.99	50	134	148
June	0.79	1.31	0	0	0
July	2.25	2.68	0	0	0
August	1.94	2.41	50	96	119
September	1.39	1.86	100	137	183
October	1.41	1.76	100	139	174
November	1.98	2.12	100	196	209
December	1.72	1.82	100	170	180
Total	20.28	23.88		1,476	1,700

Rainfall station = Indiantown.
Soil type = 0.8 inch.
Acreage = 1,821.

Sod

The sod projections presented here refer to irrigated sod. There is additional sod harvested from pastureland which is not irrigated.

St. Lucie County. Currently there are two companies producing irrigated sod in St. Lucie County. Based on an annual agricultural commodity report (IFAS, 1989) and communication with the local IFAS extension office (phone conversation 1991 with J. Cummings, St. Lucie County Extension Office, Cooperative Extension Service, IFAS, Ft. Pierce, FL.) a total estimate of 760 acres was made for these two companies. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical acreage data, and this acreage has remained constant in recent years. Therefore, irrigated sod acreage was projected to remain constant through the year 2010 (± 15 percent). The primary projection for the six time horizons is 760 acres, and the primary range is from 646 to 874 acres.

The irrigation requirements in Table G-42 were calculated by applying the current irrigated acreage to the Blaney-Criddle permitting model. Input variables used were 760 acres of grass, sandy soil with 0.8 inch usable soil water capacity, seepage irrigation systems with an irrigation efficiency of 50 percent, and Ft. Pierce as the rainfall station.

TABLE G-42. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in St. Lucie County.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	0.79	1.01	33	42
February	0.96	1.20	40	50
March	2.18	2.47	90	102
April	3.33	3.67	137	151
May	4.28	4.74	177	196
June	3.88	4.58	160	189
July	4.74	5.36	196	221
August	4.37	5.01	180	207
September	2.47	3.24	102	134
October	1.54	2.21	64	91
November	1.80	2.05	74	85
December	1.20	1.40	50	58
Total	**31.54**	**36.94**	**1,302**	**1,525**

Rainfall station = Ft. Pierce.
Soil type = 0.8 inch.
Acreage = 760.

Martin County. According to the local IFAS extension office, there are about 100 acres of irrigated sod produced annually in Martin County. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical data. Therefore, irrigated sod acreage was projected to remain constant at 100 acres through the year 2010 (± 15 percent). The irrigation requirements are presented in Table G-43. Irrigated sod in Martin County is produced primarily in Hobe Sound, which is of closer proximity to Stuart than to Indiantown, Input variables used were 100 acres of grass, sandy soil with 0.4 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Stuart as the rainfall station.

TABLE G-43. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in Martin County.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	1.02	1.15	4	4
February	1.24	1.38	4	5
March	2.53	2.71	9	10
April	3.76	3.97	14	14
May	4.55	4.85	16	18
June	4.18	4.65	15	17
July	4.79	5.24	17	19
August	4.73	5.14	17	19
September	2.69	3.22	10	12
October	1.76	2.22	6	8
November	2.24	2.38	8	9
December	1.34	1.47	5	5
Total	34.83	38.38	126	139

Rainfall station = Stuart
Soil type = 0.4 inch.
Acreage = 100.

Okeechobee Area. The local IFAS extension office estimates that there are 350 acres of irrigated sod in Okeechobee County, all of which takes place in the District (phone conversation 1992 with Oliver Miller, IFAS Cooperative Extension Service, Okeechobee, FL.). Of this 350 acres, about 100 acres takes place in the UEC Planning Area. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in the Okeechobee Area.

Therefore, irrigated sod acreage was projected to remain constant through the year 2010 (±15 percent). The primary projection of 100 acres was applied to the supplemental water requirements for sod at the Okeechobee rainfall station to yield the irrigation requirements. Other variables used were a usable soil water capacity of 0.8 inch, seepage irrigation systems with an irrigation efficiency of 50 percent. Irrigation requirements are presented in Table G-44.

TABLE G-44. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in the Okeechobee Area.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	0.95	1.07	5	6
February	1.13	1.27	6	7
March	2.05	2.27	11	12
April	3.28	3.52	18	19
May	4.17	4.51	23	24
June	3.34	3.93	18	21
July	3.97	4.53	22	25
August	4.03	4.54	22	25
September	2.62	3.16	14	17
October	2.43	2.78	13	15
November	2.22	2.33	12	13
December	1.35	1.45	7	8
Total	31.54	35.36	171	192

Rainfall station = Okeechobee.
Soil type = 0.8 inch.
Acreage = 100.

Cut Flowers

Martin County is the only producer of cut flowers in the UEC Planning Area. The local IFAS extension office estimated that approximately 40 acres of land is used at any one time for cut flower production. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical data. Therefore, irrigated cut flower acreage was projected to remain constant at 40 acres through the year 2010.

Currently the Blaney-Criddle permitting model has no category of cut flowers, and the value for sod is used for permitting purposes. Supplemental water requirements for sod on 0.4 inch soil in Martin County were applied to the cut flower acreage of 40 acres, and sprinkler irrigation systems with an irrigation efficiency of 75 percent, to calculate the irrigation requirements.

Cut flowers grown in Martin County are usually cultivated from July through May, with no production taking place in June. This is reflected in the irrigation requirement calculations in Table G-45.

TABLE G-45. Supplemental Water Requirements and Projected Irrigation Requirements for Cut Flowers in Martin County.

Month	Supplemental water requirements		Percent in ground	Irrigation requirements	
	Average (inch)	2-in-10 (inch)		Average (MG)	2-in-10 (MG)
January	1.02	1.15	100	1	2
February	1.24	1.38	100	2	2
March	2.53	2.71	100	4	4
April	3.76	3.97	100	5	6
May	4.55	4.85	50	3	4
June	4.18	4.65	0	0	0
July	4.79	5.24	50	3	4
August	4.73	5.14	100	7	7
September	2.69	3.22	100	4	5
October	1.76	2.22	100	3	3
November	2.24	2.38	100	3	3
December	1.34	1.47	100	2	2
Total	34.83	38.38		38	42

Rainfall station = Stuart.
Soil type = 0.4 inch.
Acreage = 100.

Ornamental Nursery

Ornamental nursery acreage in the UEC Planning Area are in St. Lucie and Martin counties. Nurseries in Okeechobee County are not in the planning area. In order to project ornamental nursery acreage in the planning area, the models shown in equations G-40 or G-41 were estimated.

$$XORN_t = f(XPOP_t, D) \quad \text{(G-40)}$$

$$XORN_t = f(TIME_t, D) \quad \text{(G-41)}$$

where:

$XORN_t$ ***= ornamental nursery acreage in X county in year t.***

$XPOP_t$ ***= historic or forecast population of X county in year t.***

$TIME$ ***= a time-trend variable equal to 1 in 1972 and increasing by 1 unit each subsequent year.***

D ***= a dichotomous variable designed to catch an intercept shift in the historical acreage data.***

Currently the District's Blaney-Criddle permitting model has no category of ornamental nursery, and the value for sod is used for permitting purposes. Supplemental water requirements for sod on the relevant soil were applied to the ornamental nursery acreage projections to calculate the irrigation requirements.

The majority of ornamental nurseries in the UEC Planning Area use overhead sprinkler systems for irrigation. Normally overhead sprinkler irrigation systems are estimated by the District to have an irrigation efficiency of 75 percent. However, an indeterminable number of nurseries containerize their plants, and this reduces the system efficiency to approximately 20 percent. To account for this range of efficiencies, an average efficiency of 50 percent was assumed. Micro irrigation systems will be required on all new container nursery projects, raising the estimated efficiency of these projects to 85 percent, and the future overall average efficiency to 80 percent. This often means that, even with increased acreage, the overall ornamental nursery irrigation demands are reduced (SFWMD, 1993).

St Lucie County. Ornamental nursery acreage has varied widely since 1972, from a low of 20 acres in 1979 to a high of 178 acres in 1978. A model of the form shown in Equation G-40 was estimated using ordinary least squares, and the results shown in Equation G-42 were obtained.

$$ORN_t = \underset{(180)}{23.8339} + \underset{}{.3853 * POP_t} + \underset{(3.71)}{68.6033 * D} \quad \text{(G-42)}$$

D = a dichotomous variable equal to 1 for the period 1984-86 inclusive and 0 for all other time periods. This dichotomous variable captures the effects of killing freezes in the mid-1980s, which required replacement of landscapeplantings.

Goodness of fit statistics
$R^2 = .5608$
F = 10.22
$Pr F>0 = .999$
D-W = 2.448
t-statistics in parentheses

When Equation G-47 was estimated using robust regression, with an value of 0.2, the results shown in Equation G-43 were obtained.

$$ORN_t = -10.0491 + .5924 * POP_t + 56.4608 * D \quad (G\text{-}43)$$
$$(2.93) \qquad (3.39)$$

Goodness of fit statistics
$R^2 = .9154$
F = 70.34
$Pr F>0 > .999$
D-W = 1.689
t-statistics in parentheses

The projections derived from Equations G-42 and G-43 are presented in Table G-46. The projections using OLS and robust regression are very close. Equation G-43 was chosen as it has better goodness of fit statistics.

TABLE G-46. Historical and Projected Ornamental Nursery Acreage in St. Lucie County.

Year	Historical	Column (E-49)	Column (E-50)	Primary Projection	Primary -15 %	Primary +15 %
1972	53					
1973	97					
1974	36					
1975	22					
1976	34					
1977	42					
1978	Unavailable					
1979	20					
1980	108					
1981	29					
1982	47					
1983	97					
1984	178					
1985	116					
1986	118					
1987	95					
1988	79					
1989	70					
1990	79					
1991	86	87	87			
Projections						
1992		88	90	90	77	103
1993		91	93	93	79	107
1994		93	97	97	82	112
1995		95	101	101	86	116
1996		98	104	104	88	120
1997		100	108	108	92	124
1998		103	112	112	95	129
1999		106	116	116	99	133
2000		108	120	120	102	138
2001		111	124	124	105	143
2002		113	128	128	109	147
2003		116	132	132	112	152
2004		118	136	136	116	156
2005		121	140	140	119	161
2006		123	144	144	122	166
2007		126	148	148	126	170
2008		129	151	151	128	174
2009		131	155	155	132	178
2010		134	159	159	135	183

Supplemental water requirements for sod on 0.8 inch soil in St. Lucie County are shown in Table G-42. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-46) to calculate the irrigation requirements (shown in Table G-47).

TABLE G-47. Irrigation Requirements (MG) for the Primary Ornamental Nursery Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	5	3	3	3	4	4
February	6	4	3	4	5	5
March	14	9	7	9	10	12
April	21	14	11	14	16	18
May	27	18	15	17	20	23
June	24	17	13	16	18	21
July	30	20	16	19	23	26
August	28	19	15	18	21	24
September	16	11	8	10	12	13
October	10	7	5	6	7	8
November	11	8	6	7	9	10
December	8	5	4	5	6	6
Total	199	135	108	128	150	170
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	6	4	3	4	5	5
February	8	5	4	5	6	6
March	16	11	8	10	12	13
April	23	16	13	15	17	20
May	30	20	16	19	23	26
June	29	20	16	19	22	25
July	34	23	18	22	25	29
August	32	21	17	20	24	27
September	20	14	11	13	15	17
October	14	9	8	9	11	12
November	13	9	7	8	10	11
December	9	6	5	6	7	8
Total	233	158	127	150	176	199

Martin County. Martin County ornamental nursery acreage has fluctuated historically, but has shown some growth in recent years. In order to project Martin County ornamental nursery acreage, the model shown in Equation G-47 was estimated using ordinary least squares and robust regression, and the results shown in Equations G-44 and G-45 respectively were obtained.

The variable POP_t is included to account for the relationship between landscape nursery plantings for new homes and population. Historical population data from the U.S. Bureau of the Census and the Bureau of Economic and Business Research, and projected population from the county comprehensive plan were utilized.

Ordinary least squares

$$MARORN_t = 59.27091 + .002821 * POP_t - 130.0754 * D \qquad \text{(G-44)}$$
$$(3.76) \qquad (2.85)$$

D = a dichotomous variable equal to 0 prior to 1989 and 1 in 1989 and after.

Goodness of fit statistics
$R^2 = .7954$
$F = 31.10$
$Pr F>0 = .999$
$D\text{-}W = 1.454$
t-statistics in parentheses

Robust regression

$$MARNORN_t = 44.2639 + .003014 * POP_t - 145.2052 * D \qquad \text{(G-45)}$$
$$(8.12) \qquad (6.06)$$

Goodness of fit statistics
$R^2 = .9544$
$F = 167.53$
$Pr F>0>.999$
$D\text{-}W = 1.631$
t-statistics in parentheses

On the basis of an examination of the goodness of fit statistics and the projections resulting from the application of the two models, Equation G-45, adjusted for the amount by which it over projected 1991 acreage, was selected to generate a set of primary projections. Projections are shown in Table G-48.

TABLE G-48. Historical and Projected Ornamental Nursery Acreage in Martin County.

Year	Historical	Column (G-44)	Column (G-45)	Primary Projection	Primary -15 %	Primary +15 %
1972	160					
1973	141					
1974	225					
1975	182					
1976	110					
1977	175					
1978	Unavailable					
1979	206					
1980	334					
1981	313					
1982	273					
1983	274					
1984	290					
1985	282					
1986	365					
1987	294					
1988	200					
1989	402					
1990	518					
1991	521	505	527			
Projectionss						
1992		534	534	534	454	614
1993		546	548	548	466	630
1994		559	561	561	477	645
1995		565	568	568	483	653
1996		578	582	582	495	669
1997		590	595	595	506	684
1998		603	608	608	517	699
1999		615	622	622	529	715
2000		628	635	635	540	730
2001		641	649	649	552	746
2002		653	662	662	563	761
2003		666	676	676	575	777
2004		678	698	698	593	803
2005		691	703	703	598	808
2006		704	716	716	609	823
2007		716	730	730	621	839
2008		729	743	743	632	854
2009		741	756	756	643	869
2010		754	770	770	655	885

Supplemental water requirements for sod on 0.8 inch soil in Martin County are shown in Table G-43. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-48 to calculate the irrigation requirements (shown in Table G-49).

TABLE G-49. Irrigation Requirements (MG) for the Primary Ornamental Nursery Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	14	25	17	19	21	23
February	17	31	21	24	26	29
March	36	66	45	51	56	61
April	55	100	69	77	85	93
May	65	119	82	91	101	111
June	57	104	71	80	88	97
July	66	122	84	94	104	113
August	66	122	83	93	103	113
September	33	61	42	47	52	57
October	20	37	25	28	31	34
November	32	59	40	45	50	55
December	19	34	24	26	29	32
Total	479	880	603	674	747	818
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	16	29	20	22	25	27
February	19	35	24	27	30	33
March	39	72	49	55	61	67
April	58	107	73	82	90	99
May	70	129	88	99	110	120
June	65	119	82	91	101	111
July	74	136	94	105	116	127
August	73	135	92	103	114	125
September	42	78	53	60	66	72
October	28	51	35	39	43	48
November	35	64	44	49	54	59
December	21	38	26	29	32	36
Total	541	994	681	762	843	923

Improved pasture

By District definition, improved pasture has the facilities in place to carry out irrigation. However, these facilities were usually designed and installed for drainage and are rarely used for irrigation. This is because the returns associated with cattle production no longer justify the expense associated with pasture irrigation. In fact, the required pumps and other equipment necessary for irrigation are usually not operable. When irrigation is used, it is usually in a period of extreme drought and is done to prevent grass from dying.

Unless there is evidence of pasture irrigation within a specific county, the assumption is made that, improved pasture will not be irrigated throughout the projection period. Although this assumption may not be the case in some rare instances it is much closer to actual production practices than the values given by any irrigation requirement model.

There is one ranch on which irrigation is routinely carried out (phone conversation 1991 with J. Cummings, Director, St. Lucie County Extension Office, Cooperative Extension Service, IFAS, Ft. Pierce, FL.). This ranch has a District water use permit to irrigate 10,000 acres, and a withdrawal allocation of 2,671 mgy. The monthly distribution was estimated using the District's Blaney-Criddle model, and is shown in Table G-50.

TABLE G-50. Estimated Monthly Irrigation Requirements for Pasture in St. Lucie County.

Month	Monthly distribution (Percent)	Irrigation requirements (Average MG)
January	4.9	132
February	7.3	195
March	11.6	311
April	16.0	426
May	19.0	506
June	5.6	151
July	11.8	316
August	11.0	294
September	0.0	0
October	0.0	0
November	7.2	192
December	5.5	147
Total		2,671

Rainfall station = Ft. Pierce.
Soil type = 1.5 inch.
Acreage = 10,000.

Cattle Watering

Water required for cattle watering was calculated as a function of the number of and type (beef or dairy) of cattle, which in turn was appraised as a function of the acreage used for pasture.

By limiting cattle population, total pasture acreage effects the water required for cattle watering . Total pasture was projected by subtracting land expansion for other purposes from the current acreage of pasture. The 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure. Note that pasture acreages may include wetlands which will not be converted to other agricultural uses. Water demand estimates for cattle watering is based on the District's allocation of 12 gal/cow/day for beef cattle, and 185 gal/cow/day for dairy cattle; (35 gal/cow/day for drinking and 150 gal/cow/day for barn washing).

St. Lucie County. In 1990, St. Lucie County had approximately 31,000 head of cattle (The Florida Cattleman and Livestock Journal, 1990), of which 1,000 were dairy cows. These cattle accounted for 167,000 acres of improved and unimproved pasture (phone conversation 1991 with J. Cummings, St. Lucie County Extension Office, Ft. Pierce, FL.). The association between cattle and acreage is 5.4 acres per head of cattle. The acreage of pasture and the corresponding number of cattle will be reduced with the expansion of other crops in St. Lucie County. Beef cattle numbers are projected to experience this reduction as dairy cattle numbers are anticipated to remain constant over the projection period.

The projected reduction in beef cattle population and the related water use for cattle watering (based on the primary acreage projections of other crops) is shown in Table G-51.

TABLE G-51. Projected Water Use for Cattle Watering in St. Lucie County.

Year	Approximate Pasture Acreage	Total head of cattle	Dairy cattle	Beef Cattle	MGD	MG/ month
1985	180,000	33,000	1,000	32,000	0.57	17
1990	167,000	31,000	1,000	30,000	0.55	16
1995	161,000	30,000	1,000	29,000	0.53	16
2000	156,000	29,000	1,000	28,000	0.52	16
2005	151,000	28,000	1,000	27,000	0.51	15
2010	146,000	27,000	1,000	26,000	0.50	15

Martin County. The 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure (including sugarcane land in fallow). The resulting projections for pasture acreage are presented in Table G-52.

In 1990, Martin County had approximately 31,000 head of cattle, of which 3,000 were dairy cows. These cattle accounted for 145,000 acres of improved and unimproved pasture (phone conversation 1991 with R. Whitty, Martin County IFAS Extension Office, Stuart, FL.). The association between cattle and acreage is 4.68 acres per head of cattle. The acreage of pasture and the corresponding population of cattle will be reduced with the expansion of other crops in Martin County. It is likely that herd reduction will be limited to beef cattle. This projected reduction in cattle population and the related water use for cattle watering (based on the primary acreage projections of other crops) is shown in Table G-52.

TABLE G-52. Projected Water Use for Cattle Watering in Martin County.

Year	Approximate Pasture Acreage	Total head of cattle	Dairy cattle	Beef Cattle	mgd	mg/ month
1985	154,000	33,000	3,000	30,000	0.92	27
1990	145,000	31,000	3,000	28,000	0.89	27
1995	141,000	30,000	3,000	27,000	0.88	26
2000	136,000	29,000	3,000	26,000	0.87	26
2005	132,000	28,000	3,000	25,000	0.86	26
2010	128,000	27,000	3,000	24,000	0.84	25

Okeechobee Area. In 1990 Okeechobee County had about 186,000 head of cattle, of which 81,000 were dairy cows (Florida Cattlemen's Association, 1990). Estimates were developed for dairy and beef cattle numbers in the Okeechobee Area based on acreages mapped by the District as dairy farms (for dairy cattle) and pasture (for beef cattle) of the area of Okeechobee County within the District. Water demand estimates were based on these cattle numbers which are shown in Table G-53. The acreage of pasture and the corresponding population of beef and dairy cattle is anticipated to remain constant in the Okeechobee Area.

TABLE G-53. Projected Water Use for Cattle Watering in the Okeechobee Area.

Area	Dairy cattle	Beef Cattle	MGD	MG/ month	MG/ year
Okeechobee County	141,000	45,000	10.02	301	3,656
Okeechobee District Area	122,670	41,850	9.21	276	3,363
Okeechobee Area	15,947	9,207	1.89	57	692

TOTAL IRRIGATED ACREAGE

Irrigated agricultural acreages for the UEC Planning Area are presented in Table G-54. The table does not include the non-irrigated land used for pasture.

TABLE G-54. Irrigated Acreage in the UEC Planning Area.

Category	St. Lucie County	Martin County	Okeech. Area	Total UEC	Percent of Total
1990					
Citrus	94,878	46,283	2,460	143,621	84
Sugarcane	0	13,433)	0	13,433	8
Vegetables	580	1,821	0	2,401	1
Sod	760	100	100	960	1
Cut Flowers	0	40	0	40	0
Ornamental	79	518	0	597	0
Improved Pasture (irriqated)	10,000	0	0	10,000	6
Total	106,297	62,195	2,560	171,052	100
2010					
Citrus	131,320	50,079	4,474	185,873	87
Sugarcane	0	13,952	0	13,952	7
Vegetables	580	1,821	0	2,401	1
Sod	760	100	100	960	0
Cut Flowers	0	40	0	40	0
Ornamental	159	770	0	929	0
Improved Pasture (irrigated)	10,000	0	0	10,000	5
Total	142,819	66,762	4,574	214,155	100

TOTAL AVERAGE ANNUAL WATER DEMAND

Estimated and projected demands for the UEC Planning Area are shown in Table G-55. Demands are presented by use classification, with agricultural use broken down into its components. The Okeechobee County Area does not have significant urban demands.

TABLE G-55. Annual Water Demand by Use Classification.

Use Classification	Average Annual Water Demand (MG)		
	1990	2000	2010
St. Lucie County			
Public Water Supplied	5,030	8,824	12,618
Residential Self Supplied	3,066	2,816	2,566
Comm. & Ind. Self Supplied	296	434	569
Recreation Self-Supplied	2,761	4,270	5,678
Landscape	1,453	2,117	2,781
Golf Course	1,308	2,153	2,897
Agriculture	79,931	95,574	106,028
Citrus	75,367	91,028	101,447
Vegetables	255	255	255
Sod	1,302	1,302	1,302
Ornamental Horticulture	135	128	170
Improved Pasture	2,671	2,671	2,671
Cattle Watering	201	190	183
TOTAL	91,083	111,918	127,459
Martin County			
Public Water Supplied	4,581	6,946	9,311
Residential Self Supplied	2,796	3,044	3,292
Comm. & Ind. Self Supplied	555	767	1,000
Recreation Self-Supplied	4,473	6,210	8,229
Landscape	683	959	1,234
Golf Course	3,790	5,251	6,995
Agriculture	47,466	48,806	50,109
Citrus	29,877	30,839	32,005
Sugarcane	14,744	15,335	15,335
Vegetables	1,476	1,476	1,476
Sod	126	126	126
Cut Flowers	38	38	38
Ornamental Horticulture	880	674	818
Cattle Watering	325	318	307
TOTAL	59,870	65,773	71,941

TABLE G-55. Annual Water Demand (continued).

Use Classification	Average Annual Water Demand (MG)		
	1990	2000	2010
Okeechobee Area			
Agriculture	2,812	3,763	4,409
Citrus	1,951	2,902	3,548
Sod	171	171	171
Cattle Watering	690	690	690
TOTAL	2,812	3,763	4,409
GRAND TOTAL	153.765	181.443	203.804

UEC Planning Area Total by Use (MGY)	Estimated 1990	Projected 2000	Projected 2010	Percent of Total 1990	2000	2010
Public Water Supplied	9,610	15,770	2,010	6%	9%	11%
Residential Self Supplied	5,862	5,860	21,924	4%	3%	3%
Comm. & Ind. Self Supplied	850	1,201	1,570	1%	1 %	1%
Recreation Self Supplied	7,233	10,470	13,907	5%	6 %	7%
Agriculture	130,208	148,142	160,545	85%	82%	79%

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